Compressed Air Magazine

SEPTEMBER 1944

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HANDLING CARGO
IN GREENLAND

Army Engineers unloading supplies for their work at that northern outpost.

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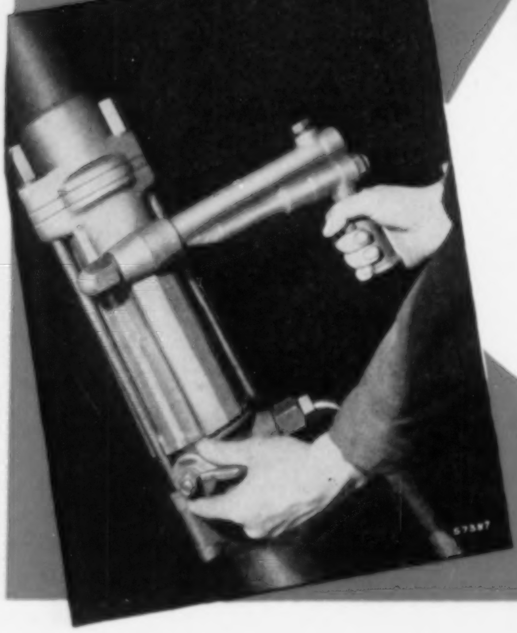
VOLUME 49 • NUMBER 9

NEW YORK • LONDON



A FEED CONTROL *that will help you* MINE MORE ORE

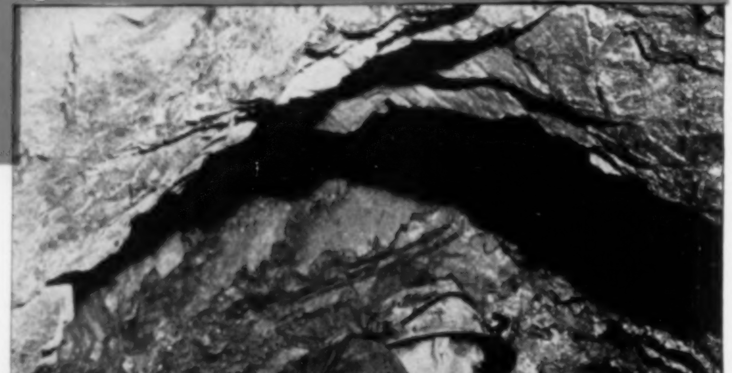
Used on the R-48 and R-58 Stopehamers

During their development, long and severe tryouts of these automatically-rotated Stopehamers were made by miners in many districts. Praise for balance, weight, throttle and feed controls, speed, minimum overall-length, and all-around ease of handling was unanimous. They had the stamp of field approval before they were placed on the market.

Their feed control is superior to any that we have ever put on a Stopehamer. An extra large feed release valve permits many fine variations in feeding power. Such flexibility means absolute control over these machines under all drilling conditions. It facilitates "collaring" a hole, too, because the bit can be held in any desired spot, even on angle faces.

Drilling in broken ground, such as through slips and mud seams, is made easier. With throttle and feed release wide open, these Stopehamers will back away sufficiently to release a fitchering steel, but they will not drop off the steel. The machines can be fully collapsed, however, by exerting a slight pressure by hand on the operating handle. With three-quarter throttle and release wide open, the weight of the machine slowly collapses the feed and permits the operator to drill back out of the hole—an advantage in soft, ravelly ground.

Try these Stopehamers and you will find that this outstanding feed control will help you mine more ore. For further details consult our nearest engineering service branch.



An R-58 Stoper driving finger raises above a slusher drift in a sub-level and slot mining system.

Ingersoll-Rand

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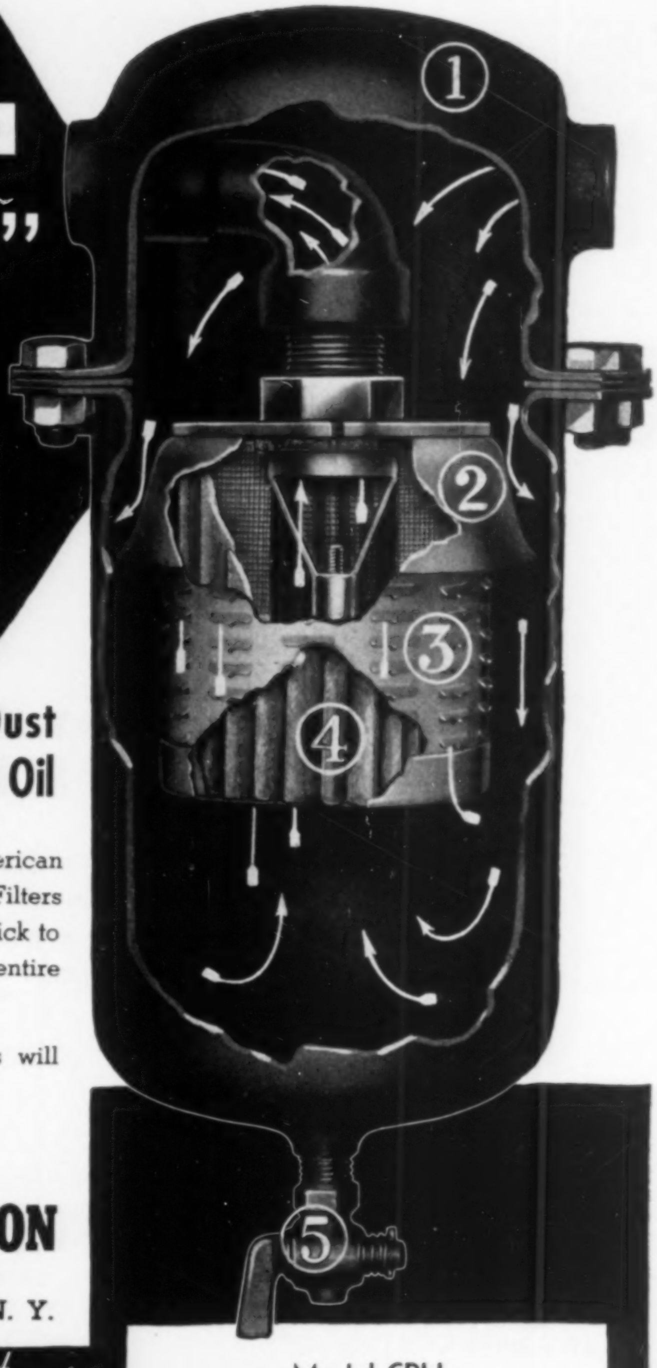
5-449

COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS • AIR TOOLS • CENTRIFUGAL PUMPS • CONDENSERS • OIL AND GAS ENGINES

More than a "Separator"

PROTECTOMOTOR PIPE LINE FILTER DELIVERS *Clean* AS WELL AS *Dry* AIR



Rust, Pipe Scale, Dirt and Dust removed in addition to Water and Oil

Repeat orders from hundreds of leading American concerns prove that Protectomotor Pipe Line Filters save money, speed production. Easy and quick to install, Protectomotors have often saved their entire cost in a single month.

Find out how in your operation Protectomotors will increase output, help win the war.

WRITE FOR CATALOG

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(Formerly STAYNEW FILTER CORP.)
7 CENTRE PK. ROCHESTER 4, N. Y.

Air Filter Headquarters

FILTERS FOR PIPE LINE, ENGINE INTAKE AND BUILDING VENTILATION

Model CPH
Double Action ★ Exclusive Construction

Air or gas strikes deflector (2), and is impinged against sides of housing (1). Oil, water, and heavy dirt particles drop to bottom and are drawn off thru drain (5). Fine dirt particles are removed from air or gas by positive action of the dry-type filtering medium which covers the patented Radial Fin Insert (4). Louvred housing (3) evenly distributes air or gas over surface of insert.

STAYNEW
PROTECTOMOTOR
FILTERS

Temperature Changes Mean Trouble in Unprotected Air Lines

Moisture in compressed air is condensed as the air passes through cold sections of pipe. Unless removed, this water washes out lubrication from air-powered tools, freezes upon expansion in these tools, and causes loss of power or stoppage due to clogging of ports; causes delays and waste at other points of compressed air usage. Staynew Pipe Line Filters (Protectomotors), installed as near point of use as possible, remove water and oil, preventing these troubles.

PIPELINES SUPPLY YANKS IN FRANCE

A vast network of pipelines now is supplying oil to Allied aircraft, tanks and motor vehicles in Normandy, London radio said today in a broadcast recorded by CBS.

"One set of pipelines carries the oil from tankers off the beaches to tanks ashore. From the tanks, more feeder lines follow the advancing Allied forces. As the advance continues, more tanks and more pipelines are added," London reported.

This invasion pipeline is coupled with Victaulic Pipe Couplings as a standard, making possible amazing speed in laying, and rapid salvage or repair.

U. S. Army Signal Corps Photo

WHEN our first invasion began in North Africa, the U. S. Army Corps of Engineers and the U. S. Quartermaster Corps were ready with the answer to the difficult logistical problem of feeding petroleum products across a beachhead. Invasion pipelines! Victaulic is proud that in North Africa, Sicily, Italy, and now in France our coupling has been a part of this great project.

BACK THIS BIG PUSH WITH A WAR BOND—SPEED THE FINAL PUSHOVER

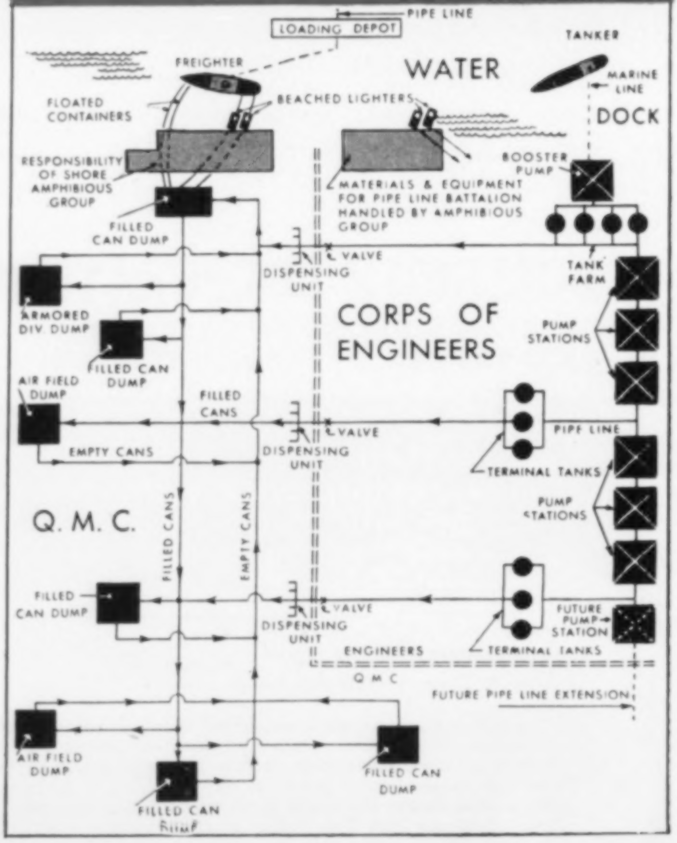
VICTAULIC

Reg. U. S. Pat. Off.

Self-Aligning Pipe Couplings and Full Flow Fittings

Victaulic Company of America, 30 Rockefeller Plaza, New York 20, N. Y.

How a modern beachhead is supplied with fuel for armored and air forces.


PIPE LINE
LOADING DEPOT
TANKER
FREIGHTER
WATER
MARINE LINE
FLOATED CONTAINERS
BEACHED LIGHTERS
DOCK
RESPONSIBILITY OF SHORE AMPHIBIOUS GROUP
MATERIALS & EQUIPMENT FOR PIPE LINE BATTALION HANDLED BY AMPHIBIOUS GROUP
BOOSTER PUMP
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VALVE
DISPENSING UNIT
TANK FARM
ARMORED DIV. DUMP
CORPS OF ENGINEERS
PUMP STATIONS
FILLED CAN DUMP
AIR FIELD DUMP
FILLED CANS
VALVE
PIPE LINE
EMPTY CANS
DISPENSING UNIT
TERMINAL TANKS
PUMP STATIONS
Q. M. C.
FILLED CANS
EMPTY CANS
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DISPENSING UNIT
FUTURE PUMP STATION
ENGINEERS
TERMINAL TANKS
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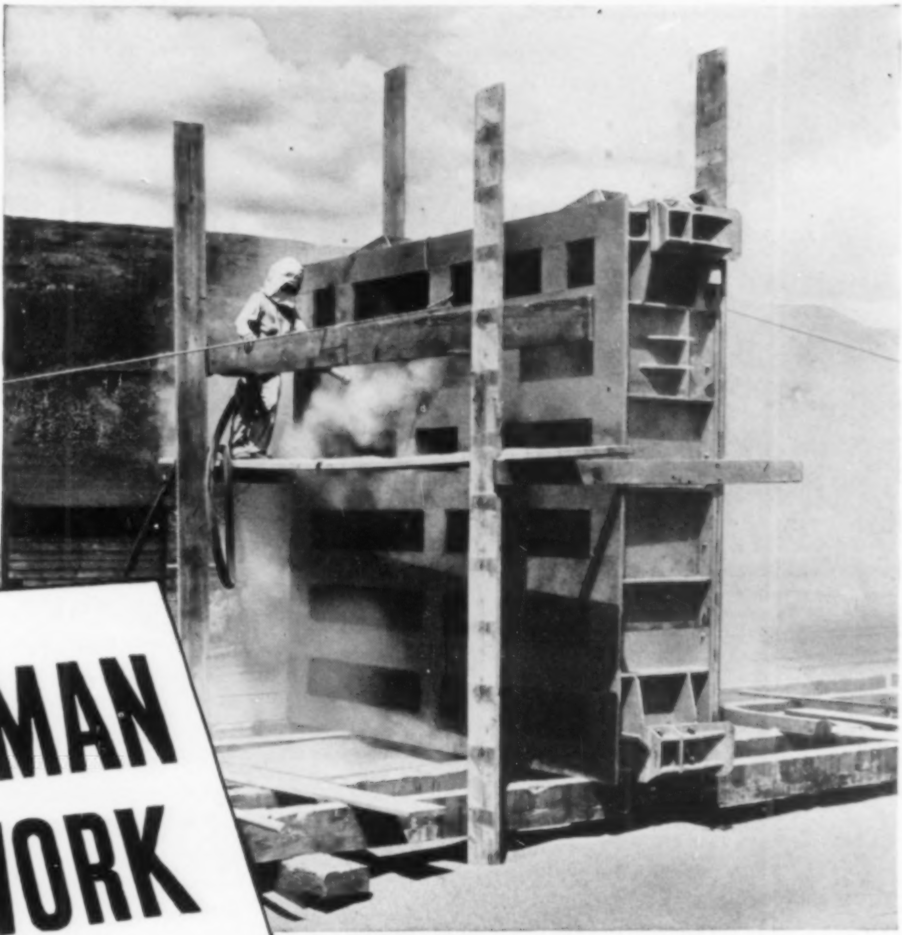
AIR FIELD DUMP
FILLED CAN DUMP
FILLED CAN DUMP

OIL MINING MARINE MUNICIPAL INDUSTRIAL



SANDMAN AT WORK

THERE'S no myth about this sandman . . . blasting scale and rust from a bulkhead gate for Grand Coulee Dam, with over 100 lbs. air pressure.

Wherever air compressors are used – building dams or in the Nation's mines and factories – maintaining uninterrupted air power requires effective lubrication...Texaco.

Texaco Alcaid, Algol or *Ursa Oils* assure wide-opening, tight-closing valves, free piston rings, open ports, clear lines. Their use in air compressors is nationwide. They assure maximum service life between overhauls, fewer repairs and replacements.

Texaco lubricants have proved so effective in service that they are definitely preferred in many fields, a few of which are listed at the right.

Texaco Lubrication Engineering Service is available to you through more than 2300 Texaco distributing points in the 48 States.

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ *More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.*

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★ *More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.*

★ *More revenue airline miles in the U. S. are flown with Texaco than with any other brand.*

★ *More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.*

TEXACO T REG. T.M.

TEXACO Lubricants

FOR ALL AIR COMPRESSORS AND TOOLS

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT – CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

Standard Motor Control

FOR POSTWAR RECONVERSION

Westinghouse All-Purpose A-C Controls

Postwar reconversion will bring important control problems—you'll need all-purpose controls—and you'll need them quick.

Westinghouse is ready NOW to help you solve these problems—with a complete family of A-C Controls, a few of which are pictured here. They offer the maximum in flexibility of application and ease of installation.

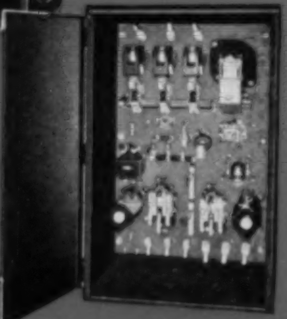
Start now to anticipate your postwar control needs. For your assistance, Westinghouse has compiled a complete new volume of Control Buying Data (Catalog 7000). Get your copy today from the nearest Westinghouse district office (distribution will be made from district offices only—no mailings from Westinghouse headquarters). Westinghouse Electric & Manufacturing Company, East Pittsburgh, Penna.

J-21307

Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Motor Control

Across-the-line A-C Magnetic Starter for Squirrel-cage Motors.



Reversing and Non-reversing Magnetic Starter.

Autotransformer Type Magnetic Reduced Voltage Starter.

Starting and speed regulating Rheostat.

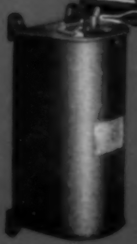
Manual Motor-starting Snap Switch.

Reversing Drum Switches for Across-the-line Starting.

Type H Sentinel Breaker for Fractional Hp Motor Starting.

Manual Multi-speed Drum Controllers.

"De-ion" Motor Watchman Reversing and Two-speed Manual Starters.

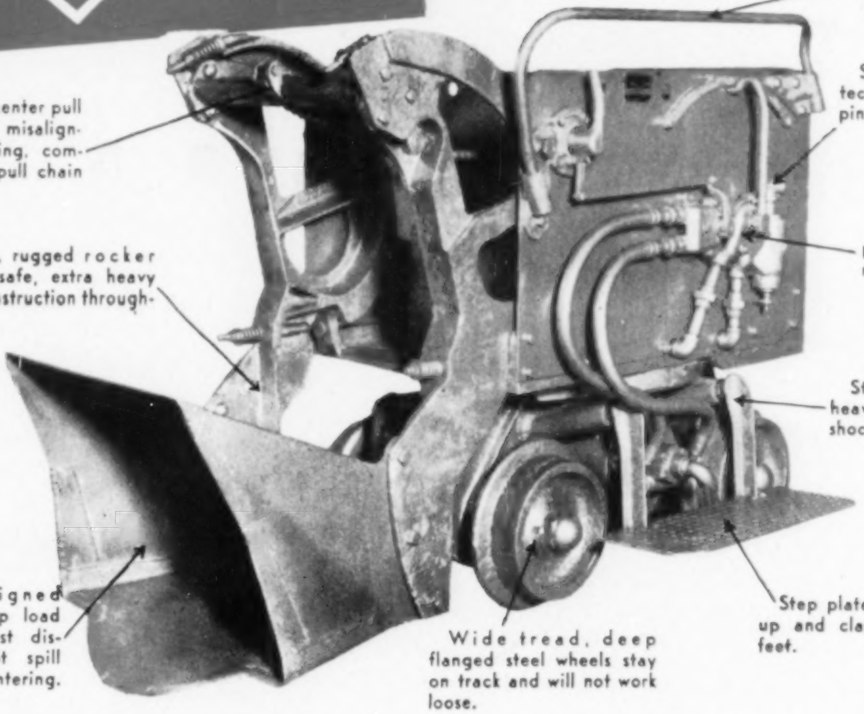


Manual Multi-speed Drum Controllers.

Across-the-line "De-ion" Manual Motor Starter.

Reversing Drum Controller for use with Primary Resistance.

Eimco RockerShovel the SAFE loader !



Guard bar — fully protects operators hands and body from moving parts.

Special inlet swivel protects operator from whipping hose.

Strong single center pull chain prevents misalignment and twisting, common in double pull chain types.

Accessability to working parts — safe for maintenance crew.

Large, rugged rocker arms — safe, extra heavy duty construction throughout.

Step plate hanger arms, heavy duty to absorb all shocks.

Carefully designed bucket. Scoops up load with minimum dust disturbance, will not spill over sides when centering.

Wide tread, deep flanged steel wheels stay on track and will not work loose.

Step plate will not fold up and clamp operators feet.

These are only a few of the many safety features of the Eimco RockerShovel that protect the operator from personal injury.

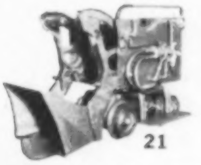
and

The Safety records established in many mines through years of continuous use of Eimco RockerShovels are unsurpassed.

Add to the above construction safety features the reaction of the Rockerman who runs the machine. RockerShovels are easier to operate. Less exertion to the man — more tons loaded in the car and don't forget—tired men have most of the accidents.

Don't risk the welfare of your loader operators—be safe—buy Eimco!

12B



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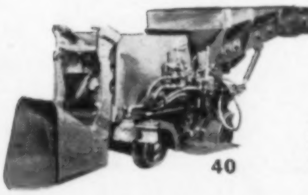
All RockerShovels are safe



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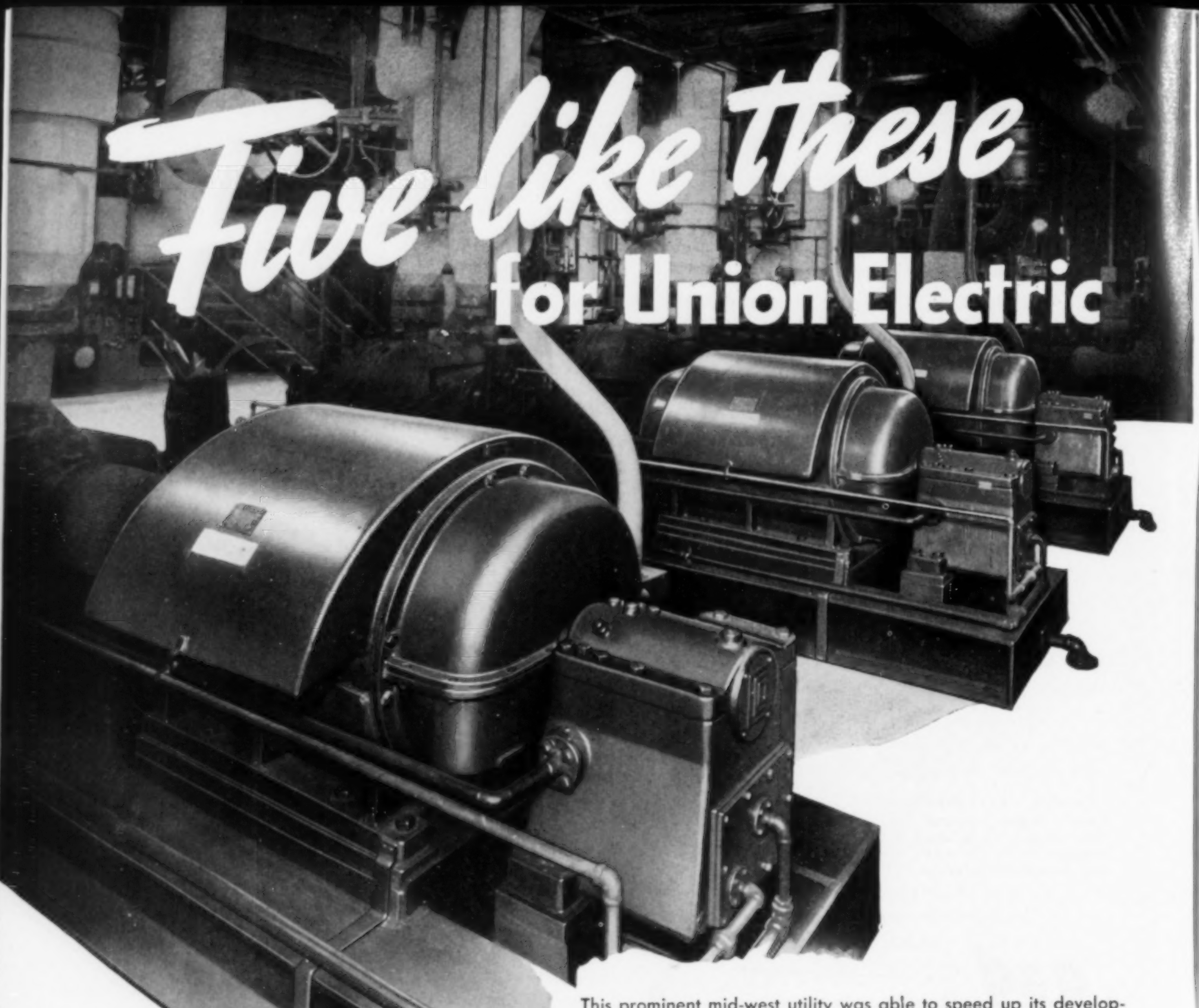


Five like these for Union Electric

This prominent mid-west utility was able to speed up its development under pressure of war needs, and get its new Venice No. 2 station on the line in time to give maximum assistance to the war effort.

In this station, Elliott motors drive the boiler-feed pumps. These motors are of the large, two-pole specially constructed drip-proof squirrel-cage induction type which are rapidly getting favorable notice in many nationally famous plants. Three of these motors (illustrated) are 800 hp and two are 1750 hp. All operate at 3600 rpm. They are equipped with an integral pressure lubricating system.

The engineering and construction of Venice No. 2 station was under the supervision of Stone and Webster Engineering Corporation of Boston.

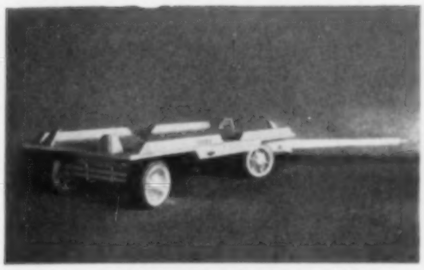
Have you a drive that calls for motors of this calibre? Discuss it with Elliott.

They're those big high-speed two-pole induction

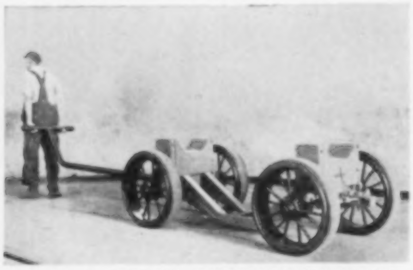
ELLIOTT COMPANY
Electric Power Department, **RIDGWAY, PA.**
DISTRICT OFFICES IN PRINCIPAL CITIES

MOTORS by ELLIOTT

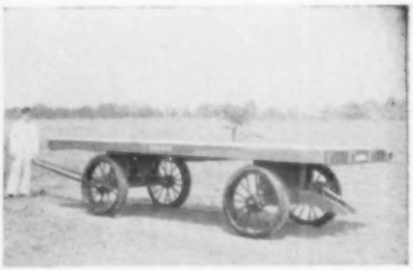
L-747



1. TRAILER FOR PICKLING BASKETS

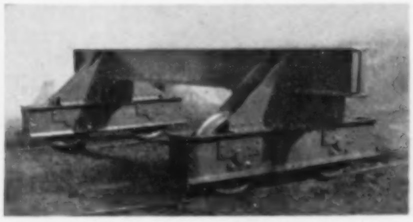


2. REVERSIBLE TRAILER FOR CRANK SHAFT

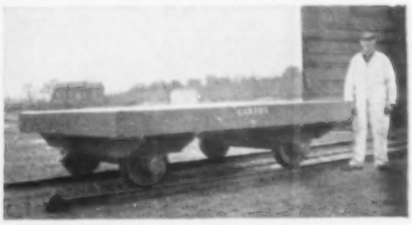


3. 10-TON PLATFORM TRAILER

4. 15-TON FRAME CAR

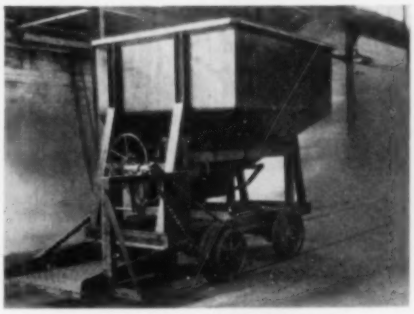


5. 50-TON CAR



6. 15-TON PLATFORM CAR

7. TIER-LIFT STORAGE BATTERY POWER TRUCK

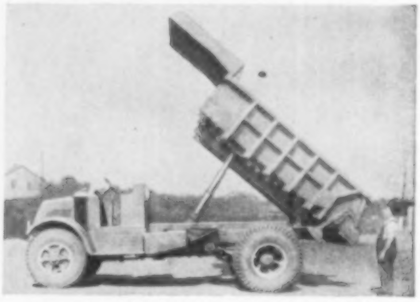


8. 150 CU. FT. CHARGING CAR

9. UNDERGROUND MINE CAR

10. BODIES FOR SIDE DUMP ORE TRUCKS

11. SEMI-TRAILER (TRACKLESS MINE CAR)



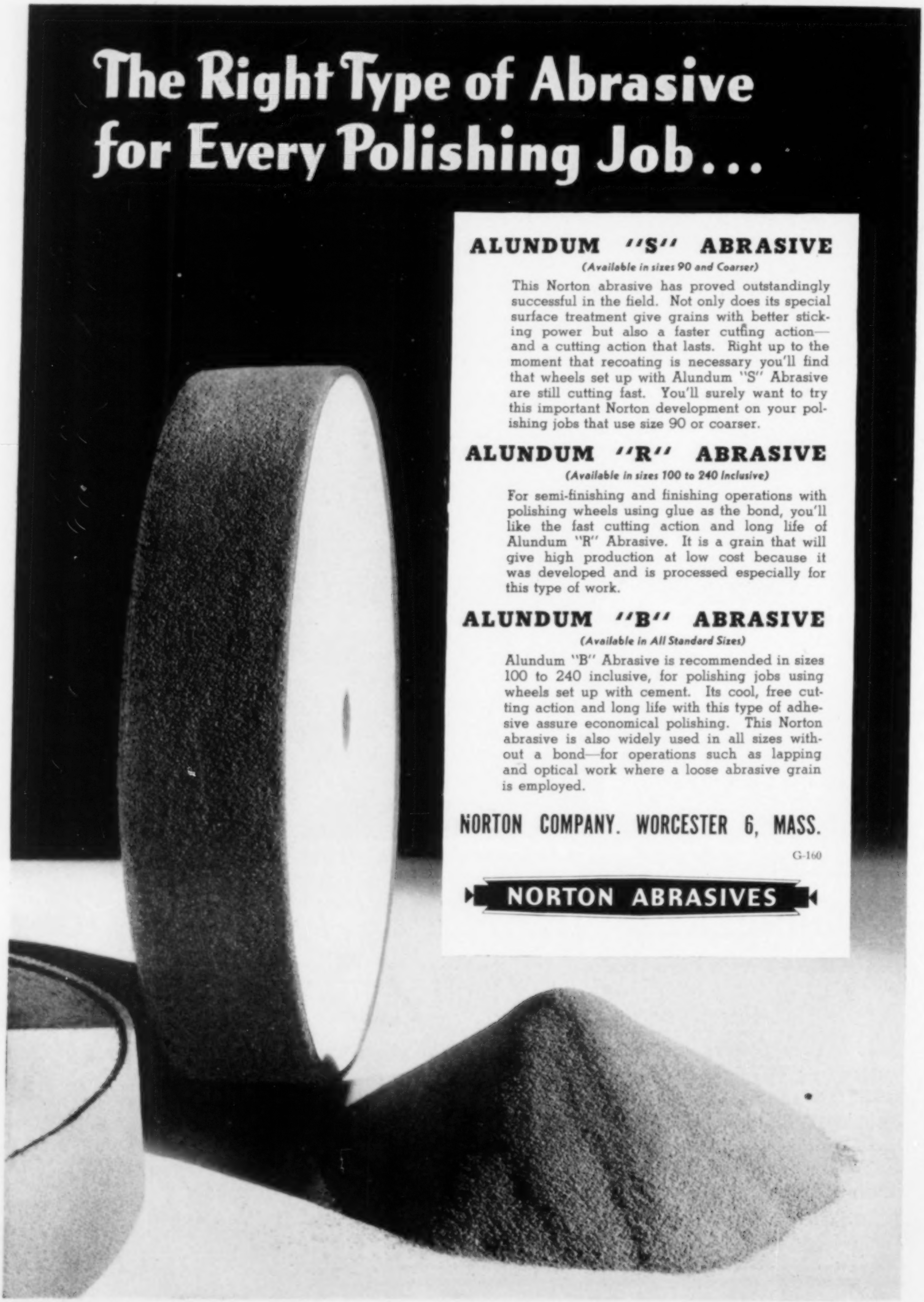
12. 9-YD. QUARRY BODY AND HOIST

ENGINEERED TRANSPORTATION IS OUR *Business*

Each of these trailers, cars and trucks is serving the varied transportation operations of one war industry—a large corporation vital to war production. All of them were engineered and built by EASTON. Some are standard models, while others were designed to meet specific problems. Still, these views show but a few of the hundreds of different types of EASTON handling equipment. Here is a wealth of "know-how" that makes EASTON your materials-handling headquarters. For information on how your handling problems might be solved, write to: Engineering Counsel, Easton Car & Construction Company, Easton, Pennsylvania.

EASTON
INDUSTRIAL CARS
TRUCK BODIES · TRAILERS
ELECTRIC LIFT TRUCKS

A—1005



The Right Type of Abrasive for Every Polishing Job...

ALUNDUM "S" ABRASIVE

(Available in sizes 90 and Coarser)

This Norton abrasive has proved outstandingly successful in the field. Not only does its special surface treatment give grains with better sticking power but also a faster cutting action—and a cutting action that lasts. Right up to the moment that recoating is necessary you'll find that wheels set up with Alundum "S" Abrasive are still cutting fast. You'll surely want to try this important Norton development on your polishing jobs that use size 90 or coarser.

ALUNDUM "R" ABRASIVE

(Available in sizes 100 to 240 Inclusive)

For semi-finishing and finishing operations with polishing wheels using glue as the bond, you'll like the fast cutting action and long life of Alundum "R" Abrasive. It is a grain that will give high production at low cost because it was developed and is processed especially for this type of work.

ALUNDUM "B" ABRASIVE

(Available in All Standard Sizes)

Alundum "B" Abrasive is recommended in sizes 100 to 240 inclusive, for polishing jobs using wheels set up with cement. Its cool, free cutting action and long life with this type of adhesive assure economical polishing. This Norton abrasive is also widely used in all sizes without a bond—for operations such as lapping and optical work where a loose abrasive grain is employed.

NORTON COMPANY. WORCESTER 6, MASS.

G-160

NORTON ABRASIVES

ON THE COVER

IN A picturesque setting at the head of a fiord, materials of every kind were received by U. S. Army Engineers who did extensive construction work in Greenland, as described in this issue. In the background are icebergs that have calved or separated from the glacier that extends down to the water's edge at the right.

•

IN THIS ISSUE

WE ARE publishing another article on the exploits of the Army Engineers because we believe current interest in their operations warrants it. This time we are presenting the story of their work in Greenland, omitting many details that cannot now be told.

•

PROBABLY not many people realize how much conveying is done pneumatically. Everyone is familiar with the tube systems that are used in department stores and similar establishments, but we are concerned here with the types that move bulk materials through conduits. They are discussed in an article by Wilbur G. Hudson, a Chicago consulting engineer. He is the author of a recently published book, *Conveyors and Related Equipment.*

•

THERE are tools for every craft, and the printer's chief tool is type. A short article reveals that there is more to type than the casual reader suspects.

•

A FEW years ago an oil company in Texas put its compressor station under slight air pressure to exclude dust. Now a foundry in the Northwest has done the same thing and finds that the results fully justify the expense involved.

•

THE art of driving tunnels through rock was well advanced even a half-century ago, as the article on *Echoes of the Simplon Tunnel* divulges. It is of interest to note that the hydraulic drills on that job quickly passed into oblivion. At least, there is no record that they were used afterward. The natural conclusion is that air-operated drills proved themselves better adapted for the work.

•

THE article *Hardwood from Softwood* is especially timely because the House Postwar Planning Committee is urging the revival of the National Program of Civilian Conservation to restore our war-depleted forests and at the same time provide gainful employment during the readjustment period when peace comes.

Compressed Air Magazine

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Army Engineers in Greenland

All Photos, Corps of Engineers

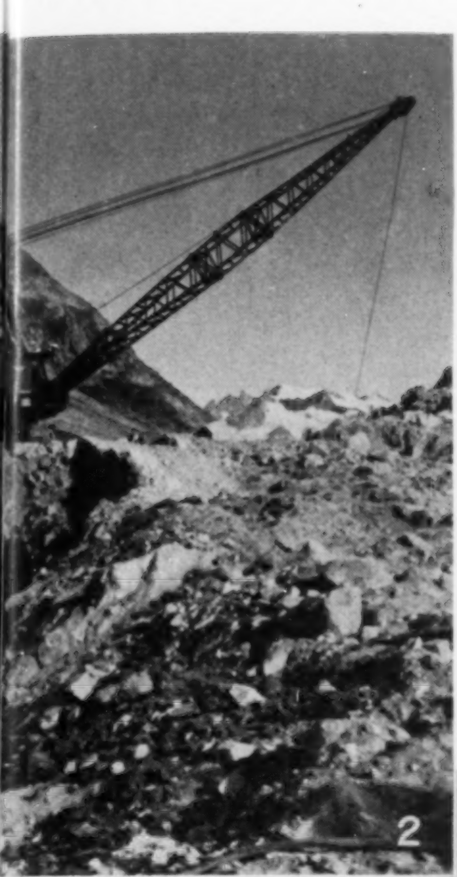
NOW that the men who did the job are back in the United States, one of the big stories of the war can be told. Great air bases, complete camps and hospitals, and numerous weather and radio stations have been built in the far northern territory of Greenland. It is the story of the invasion of the Arctic by the Corps of Engineers, U. S. Army, and by hundreds of workmen employed by civilian contractors. Never before have so many men ventured into those uncharted wilds. Not a small, rigorously conditioned group in quest of adventure or scientific data, these men were engineers, carpenters, machinery operators, riggers, roadbuilders, clerks, and cooks, and their business was construction.

On April 9, 1941, a year to the day after Germans marched into Denmark, Americans set foot on the fiord-cut shores of Greenland. The difference was, of course, that the Americans landed by agreement on what had been Danish territory in order to prevent the invasion in force of the Western Hemisphere. Germans were already there, and the last of their known installations was not destroyed until the summer of 1943, but the principal enemies were ice and isolation.

If Australia is considered a continent, Greenland is the largest island in the world. It is 1600 miles long and has a maximum width of about 500 miles, but 90 percent of it is covered by the great ice cap. The only "habitable" section is the mountainous, deeply fiord-cut shore line. As a colony of Denmark, it had been completely isolated from the rest of the world to "protect the natives from the ravages of disease and alcohol." The only profitable exports were furs and cryolite, which were shipped to Denmark and then transported to other countries for ultimate sale.

The cryolite mine at Ivigtut is the world's only known source of this aluminum fluoride, which is used as a catalyst in the refining of aluminum. Prior to the war the output was divided almost equally between the United States and Germany; now it goes directly to Canada and the United States. There may be other mineral resources; but, with the exception of a low-grade coal, none has yet been discovered.

There is very little plant growth of any character on the island and there are few domestic animals. Some sheep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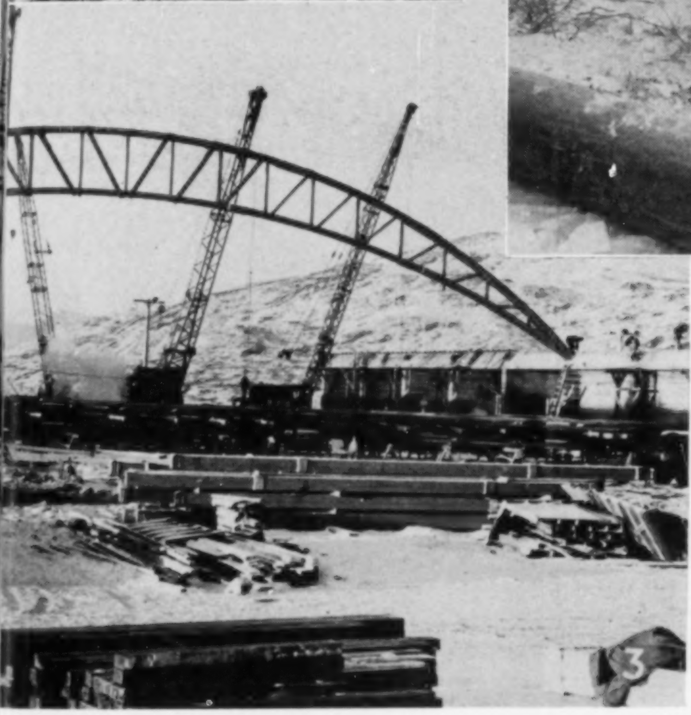
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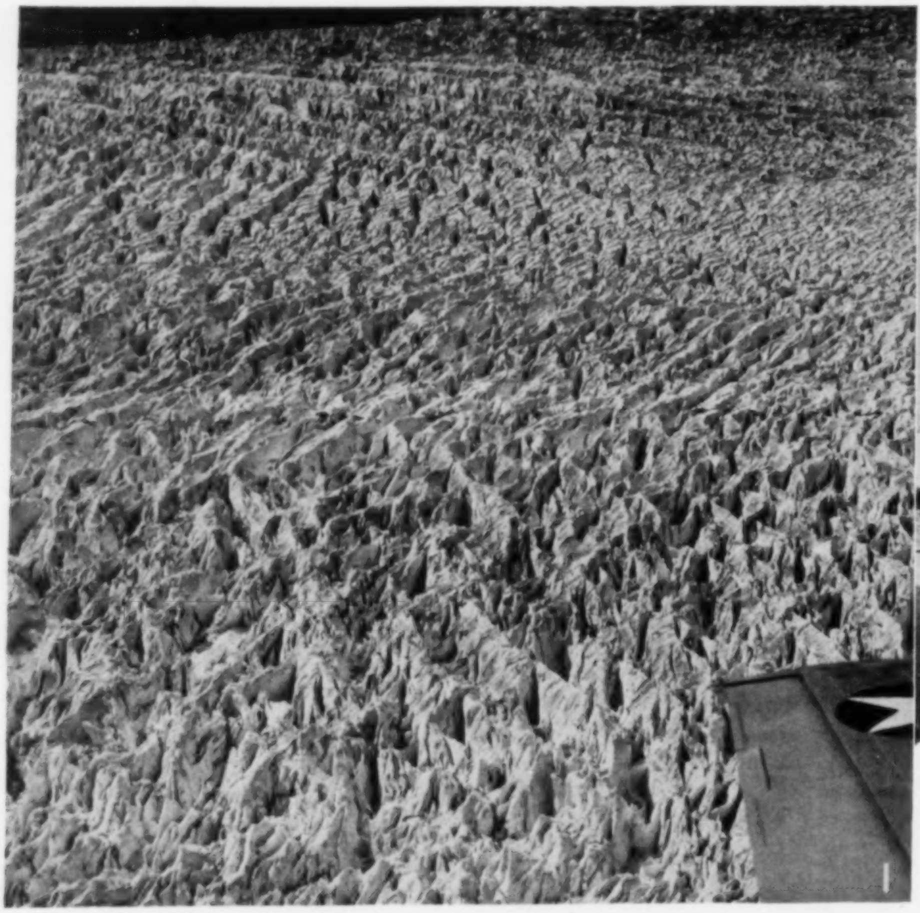
CHANGING GREENLAND'S ROCKY FACE

Modern construction machinery helped the Army Engineers win their 27-month battle against the elements during which they erected structures of varied types that make this northern outpost useful in the conduct of the war. 1- A summer scene, showing Jackhamers excavating rock on the shore of a fiord. They are powered by a portable compressor. 2- Digging a trench to house pipes for draining an airfield runway. 3- A wide-arc, wooden hangar truss is lifted into place. 4- Drilling a building foundation in winter. The 315-cfm. portable compressor at the left is mounted on skids and is moved about by the tractor shown with it. 5- An air-operated tamper being used to consolidate fill for a hangar wall.

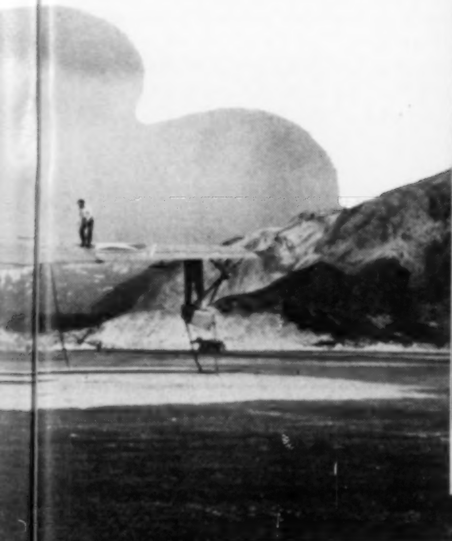
are raised for local consumption, and the only cows are those that supply milk for the children of the Danish colony at the cryolite mine. Practically all the fodder for these creatures has to be imported. Travel between the small communities is entirely by water, or by sled over snow and ice in winter. This is in striking contrast to a road that has just been built by the Army Engineers between one of their camps and an airfield and weather station. This highway is 13 miles long.

Today, because of its bases, Greenland is a vital link in the Great Circle route to Europe and the place where we do much of our weather forecasting for the war we are waging in Europe. The Germans had meteorological stations near the great ice cap from which they sent home weather reports to guide the air forces in their blitz on England. They probably had anchorages in the fiords for supply and refueling ships for submarines when they ranged in wolf packs in the North Atlantic. It is worth mentioning that the Italians under Balbo had used a lake on the island in 1933 for



an overnight stop in the first mass flight in history across the North Atlantic.

The advantages of bases in Greenland were obvious, but the hazards presented by the elements and the uncharted regions of both land and sea loomed ominously over a large-scale invasion of the Northland. With the coöperation of the newly formed local government, however, a joint Army-Navy survey party located sites for the principal air bases and weather and radio stations in the spring and early summer of 1941. Construction was assigned to the Corps of Engineers. Direct responsibility was delegated to the North Atlantic Division, with offices in New York City. Contracts were made with two civilian companies—McWilliams Dredging Company and Nick F. Helmers, Inc.—in a joint adventure, and men and supplies were landed in September at various points along the jagged coast before the long winter set in and ice cut them off from the rest of the world. Unloading supplies and construction of the camps went on simultaneously until December, when the last ships, empty and riding high in the water, nosed back down the already icy fiords. Men turned their backs on those disappearing vessels, knowing that their last ties with home were severed until late the following spring.



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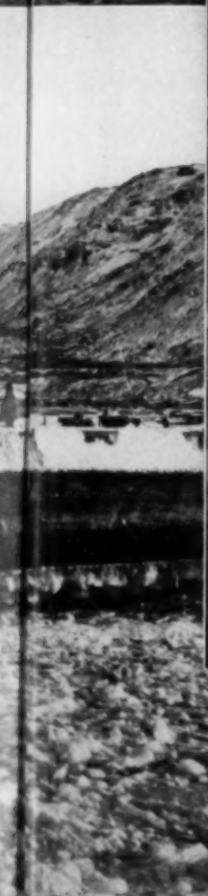


3

AUSTERE BUT BEAUTIFUL

1- Stresses and strains induced by the slow movement of the great ice cap that covers the whole of the island's interior open up crevasses from 75 to 150 feet deep around its edges. The ice cap is 721,000 square miles in extent and has a maximum estimated thickness of 1000 feet. 2- Steel grating imparts a level surface to an airfield where planes have to be well anchored against the action of high winds. 3- Unloading supplies from a barge at a rock-filled crib. 4- A small boat making its way through ice flows by the light of the midnight sun. 5- Drillers working through the gales of an arctic night. Note the electric light bulb at the lower right.

That Christmas was declared a day of rest, the first, for work went on practically around the clock in 10-hour shifts, seven days a week. At one camp beyond the Arctic Circle, Christmas presents did not arrive until May. They reached the fiord by Coast Guard cutter and were then taken in by dog sled. The first mail in 100 days was flown in by an American pilot in the service of the Canadian RAF. The winter of 1941-42 was the most harrowing for the men because of the element of uncertainty as to the weather. But hard work maintained excellent morale. The temperature fell to 60° below zero Fahrenheit, but even in the northernmost camp extreme cold caused the loss of only two working days.

Most of the building operations were similar to those carried on in the northern part of the United States. In pouring concrete in subzero temperatures, the practice of preheating the aggregate was followed and the forms were covered with tarpaulins. These were kept hot for 48 hours by means of steam and airplane-engine preheaters, and were then allowed to cool slowly. The steam maintained a moisture balance which would have been destroyed if only the engine heaters had been used.

Types of construction varied as the temperature varied from temperate to arctic; and in the northernmost bases, "permafrost" was something new for those whose activities had been confined to the United States. Col. G. R. Rathjens, Greenland District Engineer, whose civilian experience between wars was that of both a mining and a construction engineer in the Far North, defines permafrost as "permanently frozen material of varying depth existing above bedrock and below the line of seasonal thaw." The Colonel explained that permafrost may be as much as 70 percent frozen moisture in volume, and that in building on or near permafrost areas it is necessary to consider carefully the possibility of a change in the natural balance and flow of water, especially in underground channels. Removing the surface insulation will result in deeper seasonal thawing and cause subsidence, so fill instead of cut must be resorted to in leveling a road or a runway. For the same reason, structures must be erected up off the surface and air circulation provided.

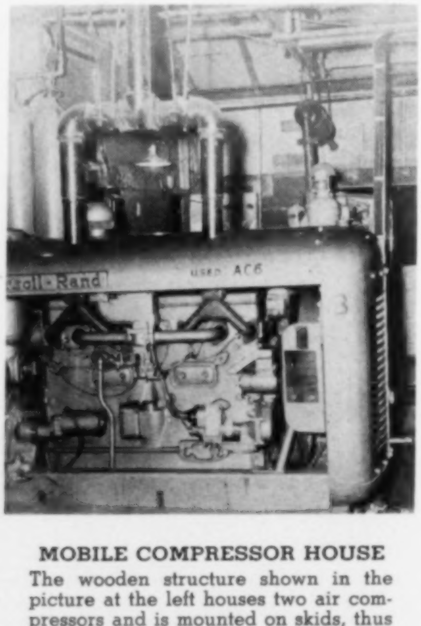
Rocky terrain dominates in Greenland, however, and a great deal of drilling and blasting had to be done. Ingersoll-Rand portable air compressors with capacities of 315 and 500 cfm. were used extensively on all the projects. For intermittent service in subzero weather (the machines operated with the thermometer as low as 60° below zero) they were housed in skid-mounted sheds, as shown in an accompanying illustration.

The water supply also presented something of a problem, for if impounded in open storage it would freeze solid during the long winter. At one site an excellent underground source was found in a glacial moraine at a depth of 80 feet. Surface installations were out of the question, however, because of the intermittent scouring by the flooded stream and icebergs. The answer was an air-lift, or California-type well. This was offset just below the surface and carried over to a sump in the side of a bordering hill. The compressors also were located at this safe point.

By test, with three wells operating simultaneously, the volume of free air (based on Ingersoll-Rand volume ratings for compressors) per gallon of water was determined to be 0.29 cubic foot. The working pressure was 16 pounds per square inch. It was discovered that the spore crenothrix—which has been dormant in these subpermafrost waters since the days of the mammoth—comes to life when the water is brought to the surface and usually makes it cloudy. But the air lift solved that difficulty, too, for the turbulence induced by the air breaks the gelatinous shield which protects the spore, thus causing it to die and leaving pure, potable water.

All supplies and equipment for living and construction, with the exception of rock and gravel aggregates for concrete and asphalt, had to be shipped in from the United States. This had to be done within the few months of summer when the fiords were clear of ice. Some of the camps had to be equipped and provisioned for a whole year, others in the northernmost outposts for two years. Since there was no means of intercommunication so far as supplies and equipment was concerned there could be no borrowing among jobs, so each camp had to be made self-sustaining.

Now the great airfields, the radio and weather stations, the camps, and the hospitals have been turned over to the Air Forces, Signal Corps, Medical Corps, the Navy, and the Coast Guard. The Army Engineers, with the exception of maintenance troops, have left Greenland after 27 months of the most arduous work during which they probably put up more and better buildings than the Danes and Eskimos constructed there since time began.

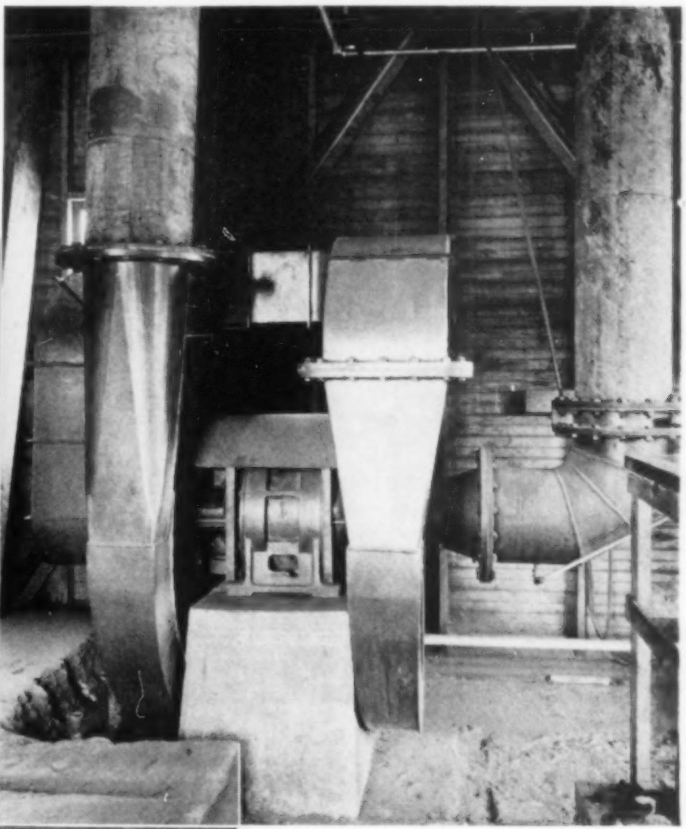


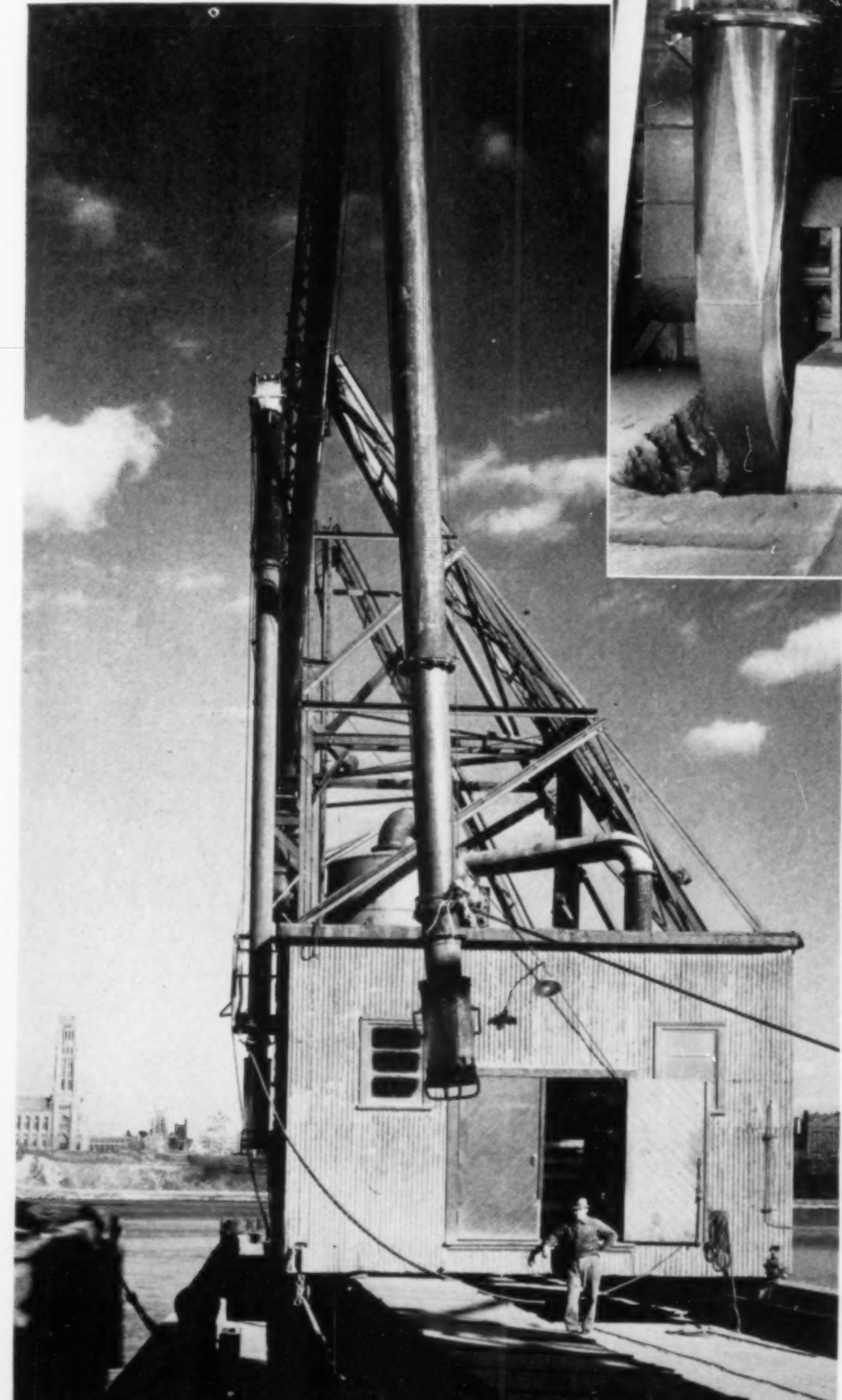
MOBILE COMPRESSOR HOUSE

The wooden structure shown in the picture at the left houses two air compressors and is mounted on skids, thus converting it into a sled that can be drawn around by a tractor as the scene of drilling changes. Above is a view inside the shanty.

Conveying Bulk Materials with Air

Wilbur G. Hudson





GRAIN-HANDLING EQUIPMENT

The picture at the left shows one of five units used at Edgewater, N. J., by Archer Daniels Midland Company for unloading water-borne grain. The entire structure, which houses the essential operating equipment, travels on rails on the pier so that it can be moved along as unloading of a barge or ship progresses. Hanging down in front of the structure is the riser with its attachment that is lowered into the grain. The latter is conveyed to the structure, where it passes through a separator and dust collector, and is then discharged onto a belt conveyor that is housed between the rails and extends to an elevator on shore. The other picture shows the two Ingersoll-Rand Motorblowers that function as exhausters to induce the suction that operates the system. A central 100-hp. motor drives both blowers which operate in series, as a 2-stage unit. Air from the separator-collector comes in at the right, goes through the first blower, passes overhead to the second one, and is discharged from it to atmosphere through the pipe at the left. The blowers handle 4500 cfm. of air at a pressure of 7½ inches of mercury, or a little less than 4 pounds, absolute.

A NATURAL example of the pneumatic conveying of materials observed daily is the carrying of dust particles by the wind; a less common one is the movement of heavy objects by tornadoes and hurricanes. These forces are uncontrolled: the velocities are not fixed, the direction of movement varies, and there is no guiding the air-material stream. In industrial pneumatic conveying, however, air velocities are regu-

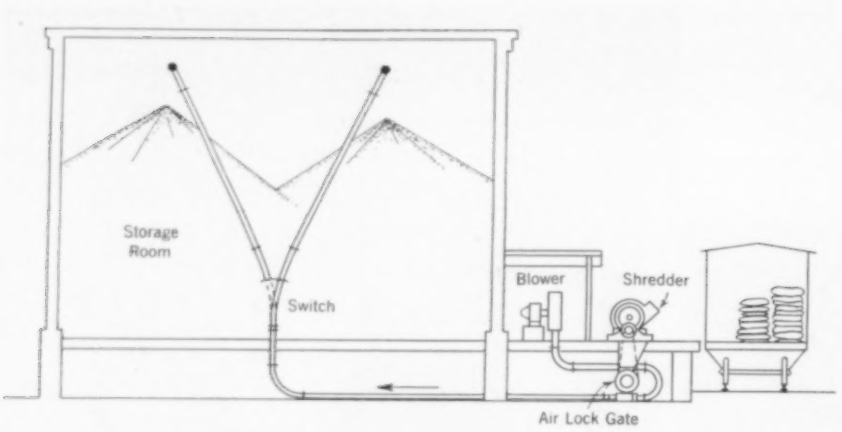


FIGURE 1- HANDLING SULPHITE PULP

Layout of a system adopted in a paper mill for shredding and stocking sulphite laps received in boxcars. By spraying from two horizontal arms high overhead, the capacity of the storage room is utilized to best advantage. Previously the folded fibrous laps were unloaded from the cars onto hand trucks, wheeled into the storage room, and stacked by hand.

lated and the air-material mixtures are definitely directed by some closed circuit such as a pipe or a duct.

This article deals only with the conveying of bulk materials—grains, coal, ashes, chemicals, etc.—by air, as distinguished from the transportation of messages, mail, etc., in containers that travel through tube systems in office buildings, stores, and even underground. It discusses only relatively low-pressure systems—those of 10 pounds or under—which differ considerably in theory and operating details from high-pressure systems. Although they are not covered in this article, it is of interest to mention some other types of pneumatic conveying. The common household vacuum cleaner is one of them. A sand-blast machine offers another example. In each case the material handled is moved only a short distance.

The pneumatic conveyor is not necessarily a substitute for the mechanical conveyor. Each has its own field of application, and choice of the one best suited for a given service is a matter of experience and engineering judgment. In general, pneumatic conveying can be used to advantage where the lift is variable (as in the unloading of a ship), where the tonnages involved are relatively small, where exposure to contamination must be avoided, and where the cost of power is relatively low.

The earliest record we have of anything approaching pneumatic conveying dates back to 1818, when the well-known ejector was invented presumably by the Marquis Mamonry d'Eclet. When two open pipes are arranged so that abutting ends form a right angle, and when steam or air at high velocity is passed through one of them, suction will be induced in the second pipe and the pressure within it will be reduced to a partial vacuum. If the bottom of the second pipe is submerged in a liquid, the latter will be drawn up through the pipe and join the stream that induced the suction. This is the principle on which the common aspirator and Flit-gun works.

The inventor of the jet used it to raise water. The first American applications of industrial pneumatic conveyors to nonliquids began about 1866 with low-velocity installations for handling dust, waste paper, cotton waste, etc. A fan served as an exhauster, drawing the material through it and out to a disposal area or to a large centrifugal-type separator. If the material was such as to stick to the fan blades or to erode them, the separator was located ahead of the fan. Twenty or 30 years elapsed before engineers adapted the pneumatic conveyor for the handling of heavier materials such as ashes, generating the air blast either by an exhauster or by a steam jet.

Thereafter, the development of pneumatic conveying was rapid, especially in connection with grain. Some of the earliest systems were designed to transfer that bulk material from boats to elevators; and at the time of World War I there were many in operation handling not only grain but malt, copra, coal, etc. Floating plants for unloading grain also made their appearance in Europe, and many are now in use the world over. There are at least five such units in New York Harbor transporting grain from freighter to barge or from ship to shore elevators.

Because of the importance of this wide field of engineering, it is of interest to study the operating principles. The movement of a particle in a stream of air is a definite function of the velocity of the air and of the specific gravity of the material. The carrying capacity depends also on the density of the air; but an air stream at lower density and higher velocity has about the same carrying capacity as an air stream at higher density and lower velocity. This is illustrated by the action in a long straight duct into which air is blown at one end. Pressure times velocity is a constant, so as the air expands, the velocity increases in proportion. If material is introduced and starts to move, it will continue to travel to the far end. The density decreases but the velocity increases, so the effectiveness of the blast as a conveyor remains constant.

If we consider a particle of material falling by gravity pull in a vertical pipe, and we counteract this movement by an upward stream of air, the downward movement will cease when the air velocity balances the pull of gravity. This is called the "velocity for balancing." If the velocity of the air is increased, the

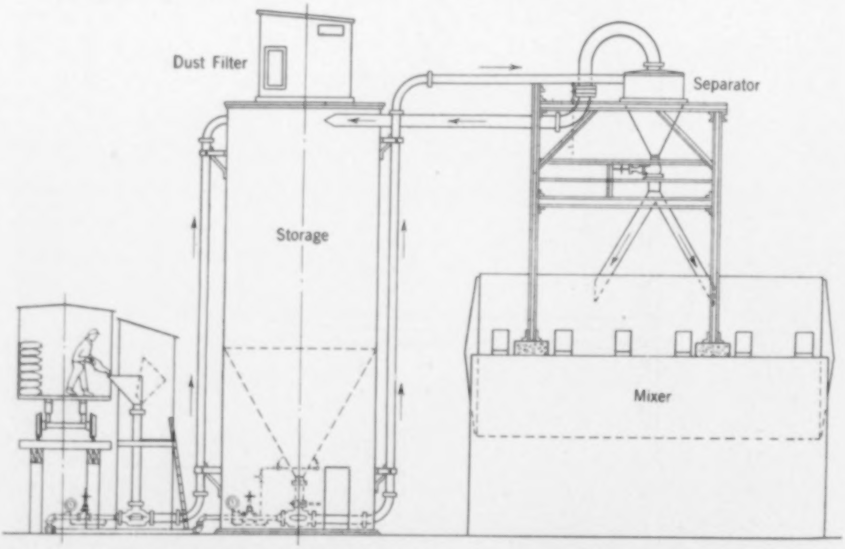


FIGURE 2- CONVEYING PULVERIZED SLATE

This system in an oil refinery conveys powdered slate from boxcars to storage and then, as needed, to a mixer, where it is combined with melted asphalt. The installation is completely dustless and practically noiseless.

particle will move upward. This is the "velocity for conveying." Thus, the actual velocity required is that for balancing, plus that for conveying and that needed to compensate for the velocity losses at the elbows, if any. The science has reached a stage where, if the specific gravity of the particles is known, the quantity and velocity of the air for a given capacity can be established with reasonable accuracy. Knowing the volume and pressure, the horsepower is easily determined.

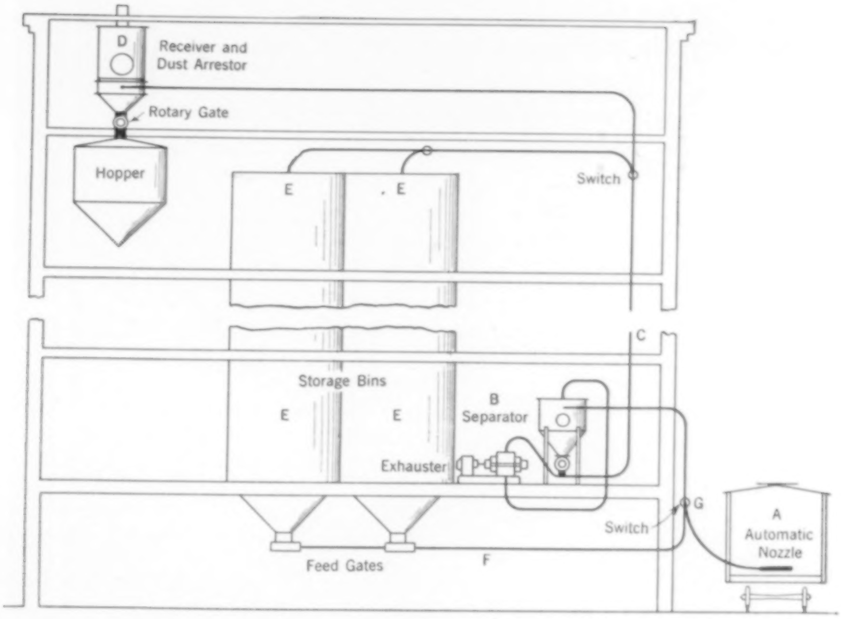


FIGURE 3- A FLEXIBLE SYSTEM

Pressure and suction are combined in this layout for unloading wheat from boxcars. The material is drawn into nozzle *A* and conveyed to separator *B*. From there it passes down through an air-lock into the pressure line *C* and is blown either to the receiver-dust collector *D* or into the reserve storage bins *E*. When the reserve supply is needed, it is drawn through suction line *F* after adjusting switch *G*. There are obvious advantages in such a system for handling dusty or harmful materials.

The pneumatic conveying of materials becomes more understandable when we think of the equipment as a pump producing a high-velocity stream in which the material floats and with which it is carried along. Otherwise it is difficult to comprehend how solids can be lifted at the rate of 100 tons or more per hour up through a pipe in which the vacuum does not exceed about 7 inches of mercury, or an absolute pressure of 23 inches of mercury. The average person associates high pressure or vacuum with these systems, whereas the conveying is done at high velocities and the suction (or pressure) is only that needed to overcome friction and to maintain the necessary velocity. Pneumatic conveyors may have the following elements:

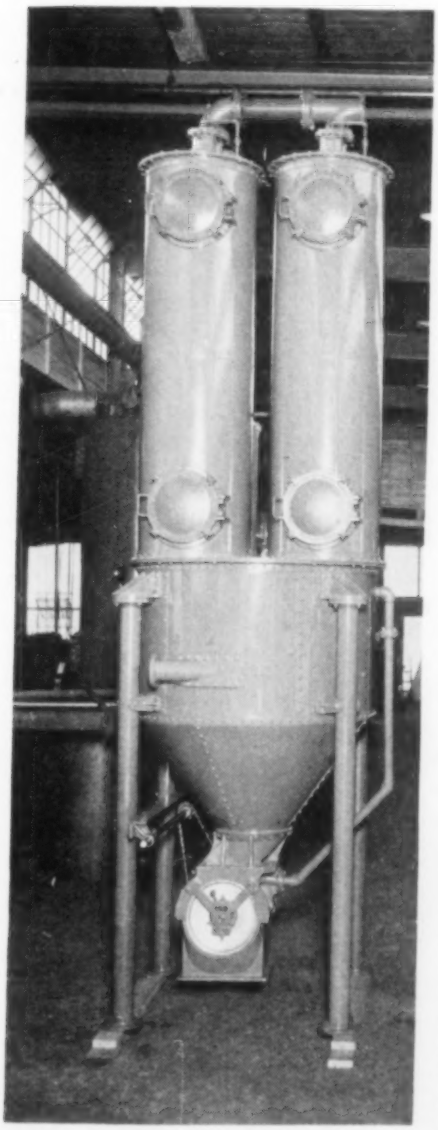


FIGURE 4- DUST COLLECTOR

The material being conveyed passes downward, while the air goes upward through cloth tubes that trap the dust. When the cloth clogs up, the unit is taken out of service automatically and the tubes are vibrated, or air is passed through them in reverse to clean them, while a second unit handles the load.

Nozzle

As the bulk material must be brought into the air stream in a fixed proportion, the nozzle must be designed so that the inflow of material will not choke off the inflow of air. Nozzles usually have a "skirt," often adjustable, which prevents blocking of the air. When the capacity is large, it may be necessary to have multiple nozzles. This introduces the difficulty of distributing the air inflow equally to each nozzle, otherwise one or another will cease to function. Nozzles are used only in "suction" systems. In "pressure" systems the material is introduced through an air-lock gate. Actually, there is no such thing as a suction system. We reduce the pressure at one end below atmosphere, and atmospheric pressure at the other end provides the air velocity.

Riser

Connected with the nozzle may be a riser to give the required lift. In systems for unloading boats, cars, etc., a degree of flexibility is necessary for convenience of operation and to eliminate needless movement of the unloader or of the boat. Telescopic risers may be provided to take care of varying lifts.

Horizontal Runs

So long as the run is straight (has no bends) the material will continue to move regardless of its length if the initial pressure has been correctly determined and gives the required initial velocity. If the run includes elbows—either horizontal or vertical bends—allowance must be made for the retarding action due to friction. This retarding action is severe if the radius of the bend is short, and decreases as the radius is lengthened.

Collecting Tanks

When the material has been conveyed to its destination it must be separated from the air stream either by a collecting tank or by a separator in which the air velocity is decreased to a point where it loses its balancing effect. Usually, a continuous discharger—referred to as an air-lock gate—must be provided. It is simply a rotary vaned member which allows the material to pass out and permits little air to leak in.

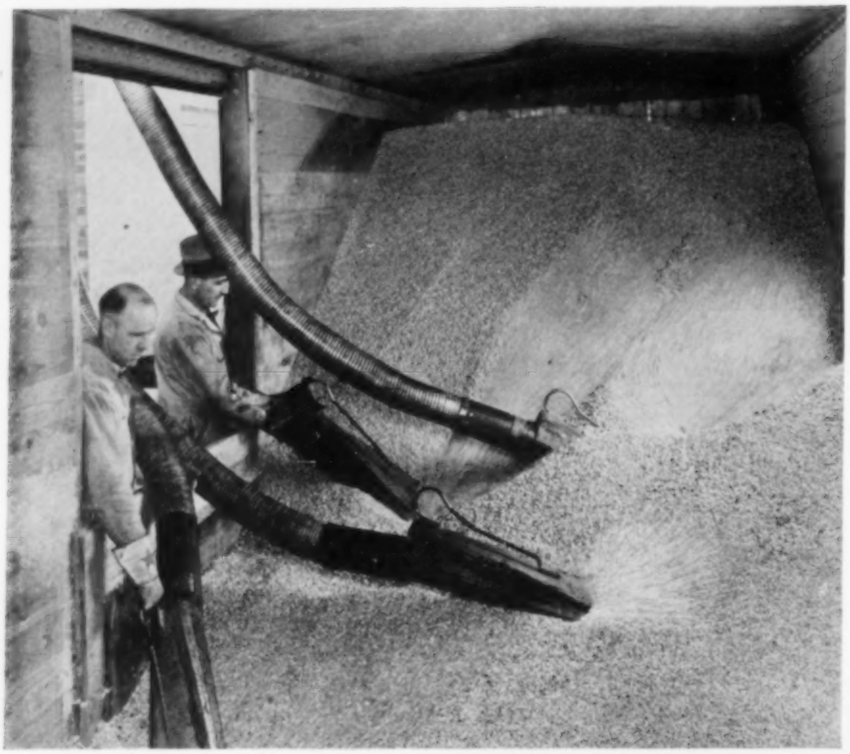


FIGURE 5- FOUR-NOZZLE UNIT

The four hoses lead to a single riser. This apparatus unloads corn from cars at the rate of 60 tons per hour. All four hoses are used until the final clean-up, when one is moved about in the ends of the car.

Dust Collectors

Regardless of the efficiency of the collecting tank, some fine dust will be carried into the air stream, so an effective dust collector is essential to protect the exhauster. There are various types: centrifugal, stocking, cloth screen, water screen, etc.

Exhausters and Blowers

To move the necessary volume of air through the system and to overcome the resultant frictional heads, some form of exhausting or blowing equipment has to be provided. There are three main types:

Reciprocating- This is a slow-speed reciprocating vacuum pump with relatively large cylinders. Although all the early systems such as the floating unloaders in New York Harbor were equipped with this exhauster, it is now rarely utilized.

Positive- The lobe type of exhauster (Figure 8) is used where the system calls for a constant volume with varying pressures. It is usually driven by V-belts which provide for ready changes in speed, if required. Should the duct become blocked, the pressure will quickly build up to the stalling point. Against that contingency the blower is equipped with a relief valve that is held shut by an adjustable spring and by-passes air into the blower should a block occur.

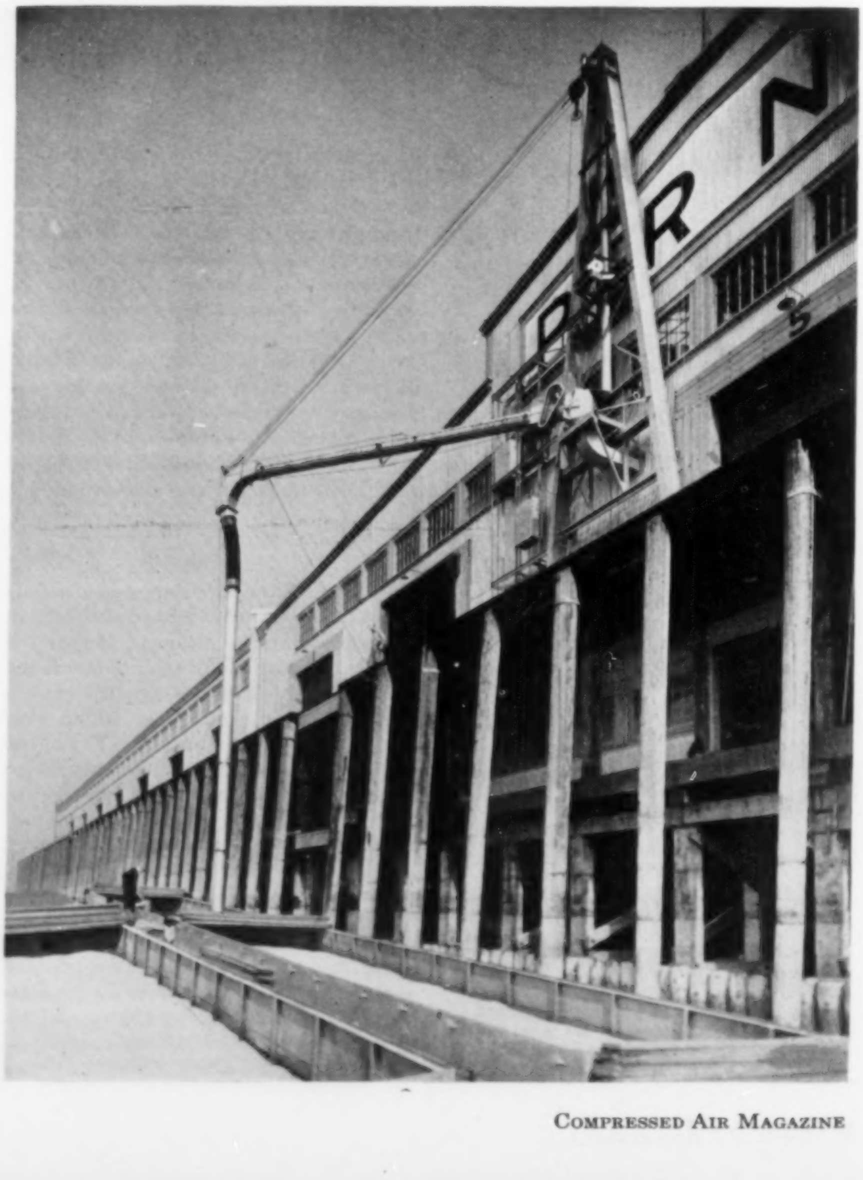
Centrifugal- Specified where conditions call for constant pressure, with or without a variable volume. It cannot build up pressure beyond that for which it is designed and therefore does not require a relief valve. In most systems the air volume runs from 5000 to 10,000 cfm. and the suction from 6 to 9 inches of mercury (below atmospheric) which permits an efficient centrifugal design. It may be either single- or multistage and close-coupled to the driving motor.

Typical Installations

Many things must be considered in determining whether a pneumatic system or a mechanical system will best answer requirements. Some materials-handling

FIGURE 6- UNLOADING WHEAT

The riser extending into the barge terminates in a manifold for five nozzles. In this case, provision had to be made by means of a boom hoist and a telescoping riser to give the apparatus a 40-foot vertical range occasioned by the tides and the change in freeboard of the barge as it is unloaded.



problems can be solved to better advantage and at less investment cost by a single pneumatic conveyor than by any combination of mechanical conveyors. The pneumatic type is not efficient in its use of power; but it is flexible, can be led over a tortuous path, is dustless, and is exceptional from the safety angle because it eliminates risk of injury to the operators. Some typical installations will serve to indicate the wide range of application of this type of conveyor.

At a certain paper mill, a folded fibrous material somewhat resembling blotting paper in texture and known as sulphite lap was formerly received in boxcars; loaded on hand trucks; and was then wheeled into a storage room to be stacked up as high as the men could reach. The laps were chopped up as needed and fed to beaters or mixers. This method of handling was replaced by a pneumatic system (Figure 1) which consists of a simple 8-inch pipe fed with air by a positive-type blower. A switch connects the riser with either of two overhead horizontal runs. A man feeds the laps to the hopper of a shredder alongside the car, and the "chips" fall downward through an air-lock gate into the conveyor duct to be sprayed into the storage room well up to the ceiling. One man thus does the work that formerly required several, the storage capacity is multiplied by four, and the material is stocked in the best possible condition for use. It would be difficult to devise a mechanical system that would handle it so neatly.

Figure 2 shows an installation at a large oil refinery. A minor operation at the plant is that of mixing pulverized slate and melted asphalt. With an ample supply of compressed air at 80 pounds available, it was suggested that it be used to do the occasional job of putting the slate into storage and feeding it to the hot asphalt. Two 4-inch pipe lines serve these purposes. A Venturi jet is located just beyond the point where the slate enters the first duct. As it sprays into the storage tank, the dusty exhaust air passes upward and out through a cloth filter. When the slate is transferred from the tank to a centrifugal separator above the mixer, the dusty air exhaust is led back to the tank and out through the same filter. As the pulverized slate tends to arch in the cone-bottomed tank, auxiliary air jets loosen the mass. Had there not been a surplus of compressed air, a positive-type blower could have provided the air blast, although the pressure would have been too low to break the arch.

Figure 3 indicates the flexibility of the pneumatic conveyor and shows a plant where grain, received in boxcars, is placed in storage bins and moved from there to a service bin in the upper floor of the building when needed for processing. When the service bin is nearly empty, it may be filled direct from the car rather than from car to storage to service bin. The grain is drawn through a nozzle and flexible hose to a centrifugal separator, whence it passes out through an air-lock gate to be caught in the exhaust from a blower and transported to the storage bins. A switch in this line serves to divert the stream to the combination stocking-type separator and dust collector that discharges into the service bin.

Stocking-type separators and dust collectors (Figure 4) are nearly 100 percent effective in separating dust from air. The air and material enter the receiver tangentially. The material skims around and downward in passing out, while the air goes up through a battery of cloth tubes (stockings) which trap the dust. As the fabric soon becomes clogged, the stocking groups are in duplicate or triplicate cylinders, and one unit after another is automatically cut out; the tubes are vibrated to free them of dust, sometimes with the aid of air passed through in reverse; and then the unit is put back in service as the next group is cut out for cleaning.

The efficiency of the pneumatic conveyor is probably most in evidence in systems that unload grain and other pulverized or granular materials from boxcars. Where the tonnage involved is very large, as in the case of a grain elevator, a mechanical system with a tilting car dumper is specified. The dumper will handle 15 or 16 large cars an hour; but the investment, including that for foundations, a big receiving hopper, and conveyor beneath it, runs well in excess of $100,000. The car dumper can therefore not be considered where small quantities are to be handled. In such cases a power shovel is frequently used because of its low first cost and low power consumption. Handled by a skilled operator, it has a capacity of 1500 to 2000 cubic feet of grain per hour, or 1200 to 1800 cubic feet of soda ash or like materials. It has several bad features, namely: the car-door bulkheads must first be broken out; it may be decidedly dangerous when operated by an unskilled man; and where pulverized material is being unloaded the operator is working in a dusty atmosphere. With soda ash this is serious, because the dust affects the mucous membrane of the nose, throat, and eyes.

Although the pneumatic unloader costs much more than the power shovel and requires about ten times the power for the same capacity, the door bulkheads remain in place while it is in service; the operator enters the car only after the way is cleared; the operation is dustless; and there is no risk of injury even to an untrained worker—in fact, running a pneumatic conveyor calls for a minimum of skill. Sometimes strict sanitary rules have to be observed. Figure 5 shows a 4-hose unloader with a free digging capacity of 2500 to 3000 cubic feet per hour unloading corn at a distillery where cleanliness is essential, as bacterial count extends to the incoming grain. The pneumatic unloader best meets the requirement.

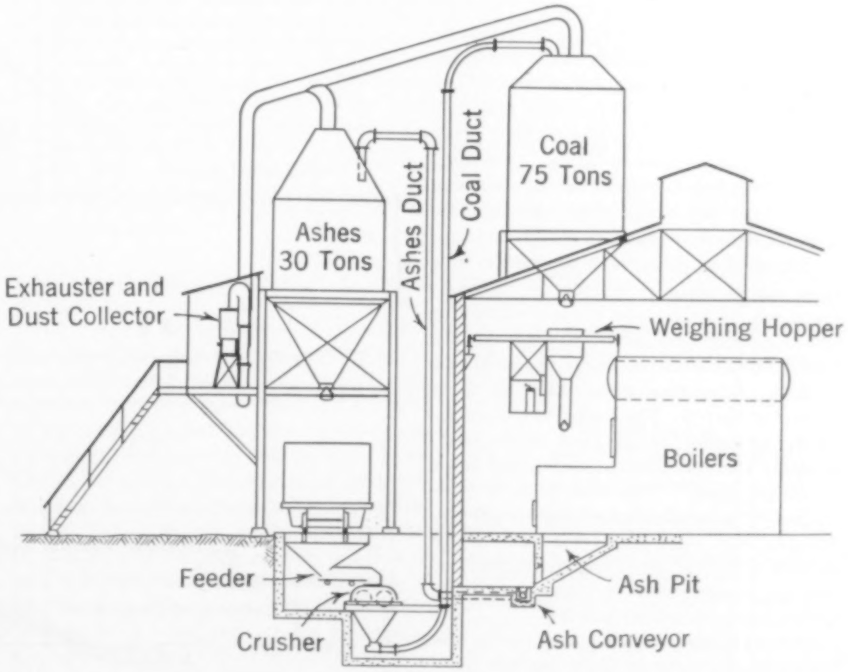


FIGURE 7- HANDLING COAL AND ASHES

Layout at a New Jersey plant where one 75-hp. exhauster supplies motive air for a dual system. Because of the availability of steam, a steam jet is sometimes used for work of this kind to induce suction by aspiration. As jets have no moving parts, they require little attention and have a long service life.

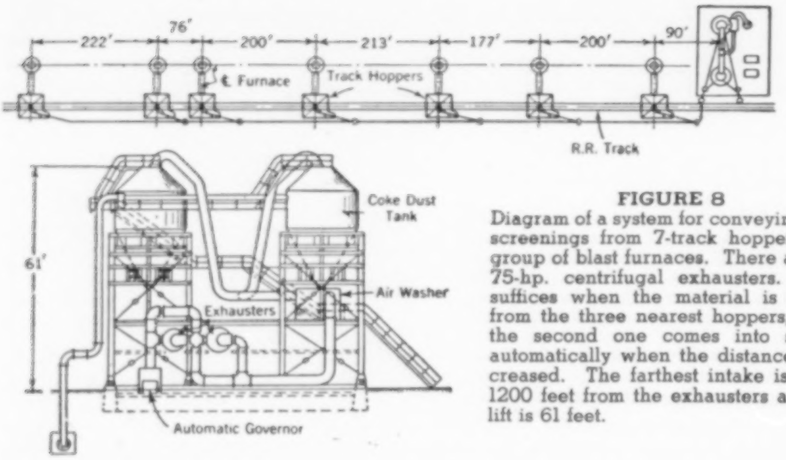


FIGURE 8
Diagram of a system for conveying coke screenings from 7-track hoppers to a group of blast furnaces. There are two 75-hp. centrifugal exhausters. One suffices when the material is moved from the three nearest hoppers, while the second one comes into service automatically when the distance is increased. The farthest intake is about 1200 feet from the exhausters and the lift is 61 feet.

At European ports of entry there is the problem of discharging grain cargoes from the holds of steamers, and the floating pneumatic unloader has been the favored equipment for this job for many years. It permits the introduction of feed nozzles into otherwise inaccessible holds, and the grain is automatically weighed as it is discharged into a barge alongside. The capacity is often more than 300 tons an hour. As we are not great grain importers, units of this type are seldom seen here, although, as previously mentioned, some English unloaders have been operating in New York Harbor for a long time. These are used to handle secondary cargoes of flaxseed while the principal cargo is being unloaded or while the vessel ties up at the dock where the major cargo is to be discharged.

Each unit has a capacity of 150 tons per hour with an English-made vertical, inverted, reciprocating exhauster. This is a costly machine. American practice has been to adhere to the rotary, positive-type, constant-volume, variable-pressure exhauster and to the higher-speed centrifugal type with its variable-volume, constant-pressure characteristic. In Figure 6 is illustrated an interesting West Coast installation for the unloading of wheat from open barges where the tide has a rise and fall of 30 feet. In addition, the level of the barge varies about 12 feet, depending upon whether it is loaded or empty. The boom of the pneumatic unloader is pivoted both horizontally and vertically at the heel by a universal joint. The riser pipe is telescoped by a small electric hoist near the inboard end. At the lower end of the riser is a 5-hose manifold to accommodate as many 5-inch flexible hoses each terminating in a feed nozzle.

The unloader is said to handle the wheat at the rate of 4000 bushels (120 tons) per hour with a 200-hp., positive-type exhauster, which is equivalent to 1.7 hp. per ton per hour, a very good performance for this type of machine. The alternative would be a "dock-leg" belt-and-bucket elevator. This would have about 20 feet more lift because of the chute at the top, and a 25-hp. motor would run the system. However, the lower power consumption would be offset by the larger crew required for clean-up, the substantially greater danger to men shoveling into the elevator boot, and the necessity of shifting the barge several times as unloading proceeded.

Another field for the pneumatic conveyor is the handling of boiler-house ashes. The air blast is maintained either by a motor-driven exhauster protected by a dust collector or by the ejector action of a steam jet. Figure 7 shows a pneumatic installation for the transfer of both coal and ashes at a New Jersey plant. A single 75-hp. exhauster alternately removes ashes through an 8-inch system at the rate at which a man can hoe them from the pits (about 400 pounds per minute) and delivers coal by a 10-inch system at the rate of 25 tons per hour.

Figure 8 shows an installation that takes coke screenings from screens beneath 7-track hoppers serving a battery of blast furnaces. It will be noted that the farthest intake is about 1200 feet from the storage tanks and that the lift is 61 feet. There are two 75-hp., constant-pressure, centrifugal exhausters protected by a water-spray air washer. One unit functions when material is fed from one of the closest three hoppers. The exhaust passes through a governor which, when the volume of air falls below a certain minimum, cuts in the second exhauster in tandem with the

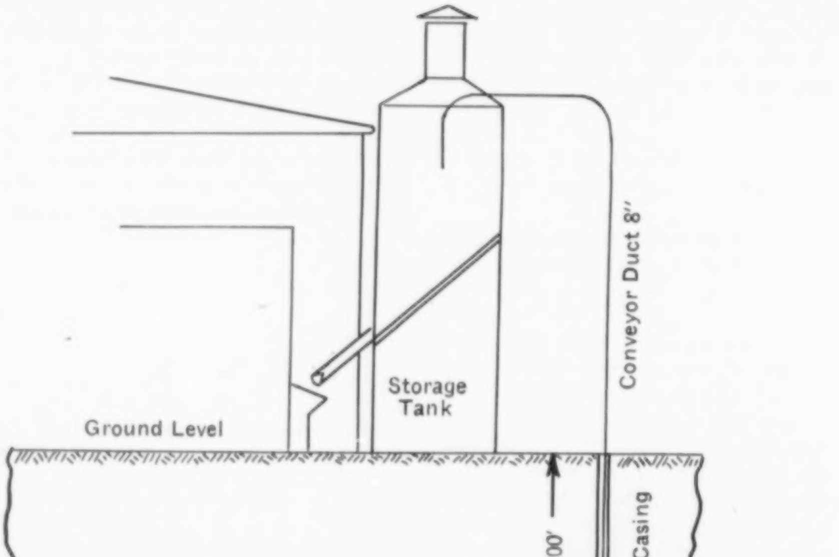


FIGURE 9- CONVEYING FROM UNDERGROUND
Arrangement of a pneumatic system used by a Pennsylvania manufacturing plant to lift coal from a seam 800 feet below the surface. This set-up eliminates the necessity of hauling the coal 1½ miles underground to a shaft, hoisting it, and then transporting it to the boiler room.

first. When the attendant passes to the fourth intake, or beyond, the pull of the exhauster is insufficient to move the necessary volume of air, and the second exhauster immediately cuts in. Should the man pass from the farther inlets back to the first three, the governor operates in reverse to cut out and stop the tandem exhauster. The installation is of unusual length for this type of pneumatic conveyor; and even though motor-driven exhausters are expensive, its over-all cost is less than that of seven feeders, a belt conveyor with housing, and a bucket elevator with overhead conveyor. Furthermore, it is far more economical in the matter of space occupied.

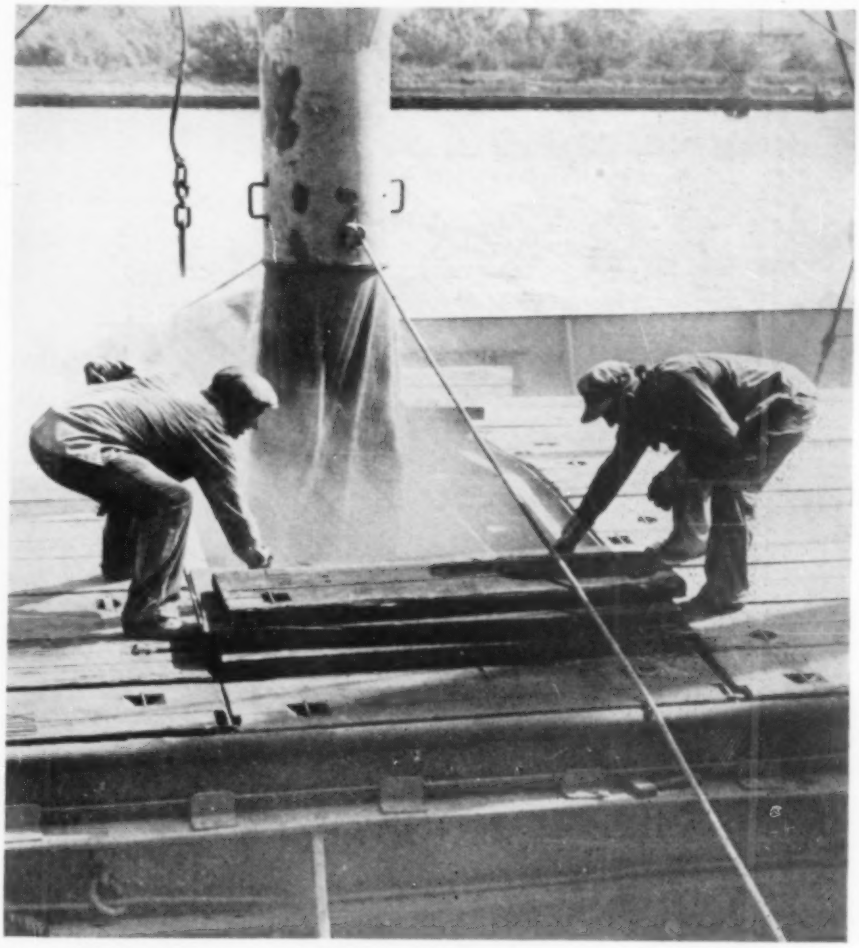


Photo by Henry M. Blatner

LOADING GRAIN INTO BARGE

Albany, N. Y., is one of the most important grain ports in the country. From the West and Northwest, grain reaches it via the Great Lakes and the Erie Canal at a low freight rate; and more arrives from South America in large ships. One Albany elevator unit has a storing capacity of 13 million bushels. All the facilities are operated under lease by private interests. The grain is transferred to and from the elevators by equipment of the most modern type of which a bulletin of the Albany Port District Commission says: "Eight pneumatic unloaders, each with a capacity of 2500 bushels an hour, draw the grain from boat or barge into the elevator. Each is equipped with an individual blower, a receiving tank, a dust collector, and a telescopic suction pipe, which searches the most remote recesses of the hold." This picture shows the delivery end of a spout that is loading grain into a barge.

Some systems are unique, as Figure 9 illustrates. A Pennsylvania industrial plant is located above a coal vein 800 feet beneath the surface. The mining company that worked the vein transported the coal to a shaft about 1 ½ miles distant. The coal belonged to the manufacturing company, which used to send a truck to the shaft whenever fuel was needed at the boiler house. When mining operations ceased there was still plenty of unmined coal to supply the plant for years, but no way to get it there. This obstacle was overcome by driving a 12-inch casing down to the vein from a point alongside the boiler house and by providing a chamber underground large enough to accommodate a feeder, a crusher, and a motor-driven blower. An 8-inch pipe was led up through the casing to a storage tank from which chutes led to the stoker hoppers. One man took care of the job of breaking out sufficient coal for the plant and feeding it to the crusher. Where power is cheap, an arrangement like this has possibilities as an alternative for the usual mine hoist and skip hoist in lifting material of medium specific gravity such as potash from deep mines to the surface.

To sum up, the pneumatic conveyor has its limitations, but it also has decided advantages in some services. It will handle any flowable granular or pulverized material that is not actively abrasive or very heavy, including corrosive materials, and will handle them at high temperatures. Its efficiency—cubic feet of air required per pound of material—goes down as the weight of the material goes up; thus for granular rock salt (80 pounds per cubic foot in bulk, 136 pounds per cubic foot in the solid) the ratio is about 326 to 1. For ground cork (5 pounds per cubic foot in bulk, 37.5 pounds per cubic foot in the solid) the ratio is about 5.6 to 1.

The pneumatic conveyor cannot handle material that is "sticky" or that will build up at the elbows of the duct—wet ashes or damp acid phosphate, for example. It should be specified with caution for a material such as sulphur that creates an explosive dust, because a fragment of steel entering the system with the material may strike a spark through impact at an elbow. An explosion occurred recently in a conveyor transferring sawdust from a woodshop over intervening buildings to boilers, but whether the blast was caused by a spark or by a flash back from the combustion chambers could not be determined. It is not suitable for unloading granular carbon black, roofing-slate granules, coffee beans, fullers earth, and other fragile products that require gentle handling. It is well adapted for systems with bends and turns such as those designed for the collection and disposal of fly ash from the soot chambers of a large steam plant. It is distinctly the apparatus for conveying foodstuffs because it meets the strict sanitary requirements imposed; and it has no moving parts in proximity to the operating men, a no less important feature. Finally, where the job involves unloading materials giving off harmful dust, it is the only type of conveyor that really eliminates the danger of injury to health.

References

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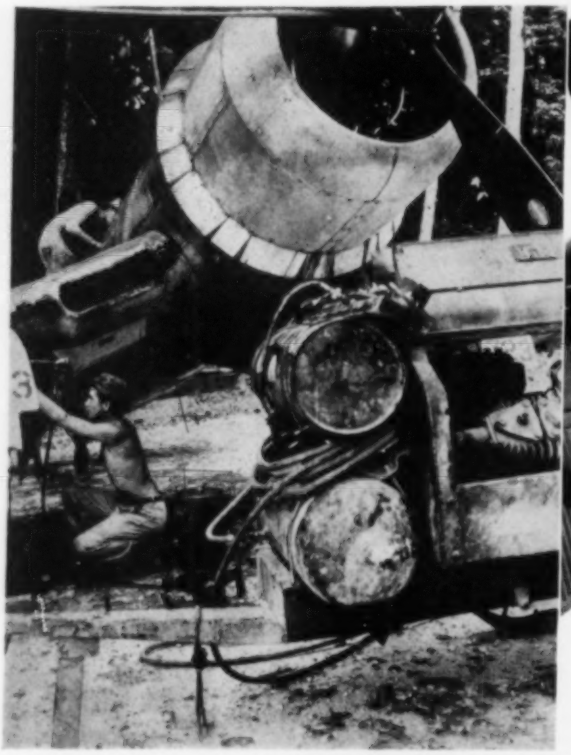
Compressed Air at Work

Photo by Gabriel Moulin



Official U. S. Marine Corps Photo

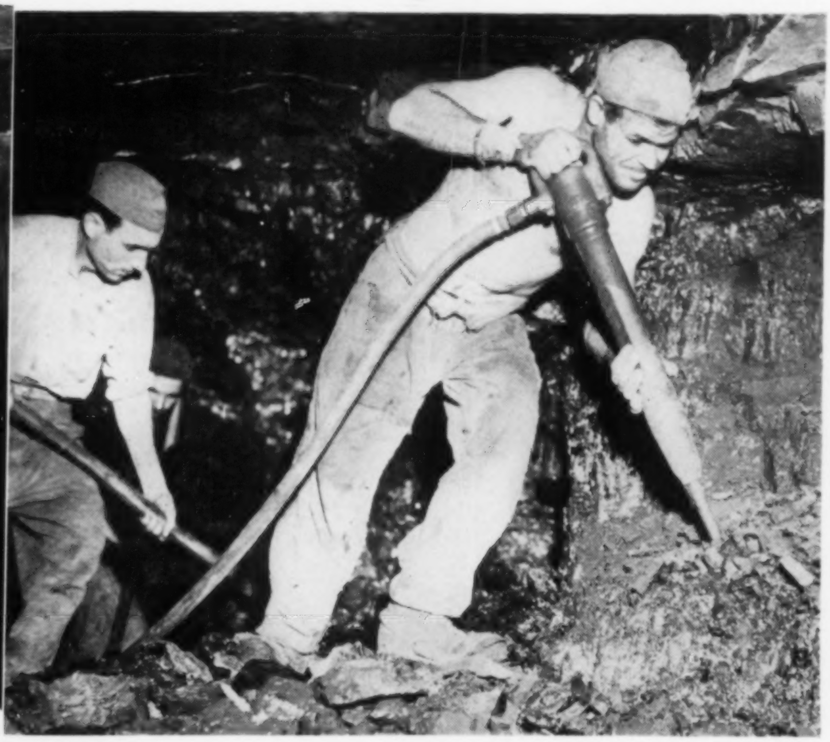
FOR every man aloft in aerial warfare there are several mechanics on the ground to overhaul the planes, replace broken or worn parts, and to do routine servicing. These ground crews work in shifts around the clock, and to them belongs a goodly share of the credit for the success of our aircraft in the skies. The picture above shows Marine mechanics giving a Corsair a careful inspection and overhauling at an air base carved out of the jungle on Bougainville Island. Every working part must be regularly and properly lubricated to insure good performance. The man at the left is using a grease gun operated with compressed air from the trailer-mounted 85-cfm. compressor in the foreground.

●

Photo by Emmett J. Pullen

AN oil-burning torch (right) is used in a Michigan factory that manufactures furnaces to preheat castings preparatory to welding them. The oil, and compressed air at 65 pounds pressure to aid combustion, are fed to the nozzle through separate pipes.

A VIEW in the shot-blast room (left, below) of the Westinghouse plant at Emeryville, Calif., where steel pellets, slightly larger than the head of a pin, are driven by compressed air at 100 pounds pressure from ⅜-inch nozzles against transformers and marine battery cases to remove rust and scale before painting them. Each operator is supplied with breathing air by a respirator that contains a replaceable filter for removing entrained oil and moisture. The steel shot falls through perforations in the floor into bins, from which it is fed in regulated amounts onto conveyor belts. The latter dump into a vertical bucket conveyor that returns the shot to the mixing chamber. Before it is reused, it is freed of dust and fine metal particles by blowing compressed air through it.



Acme Photo

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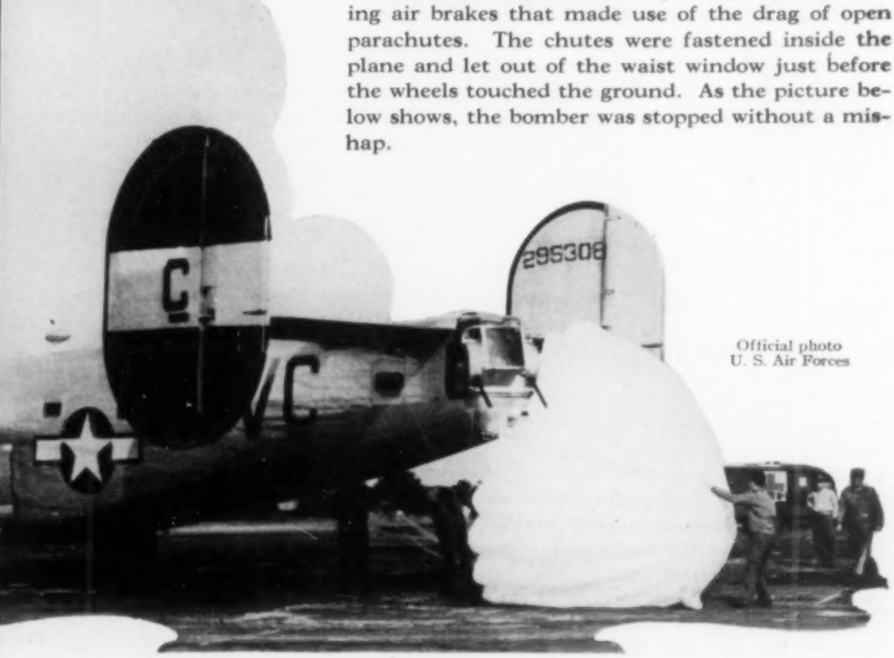
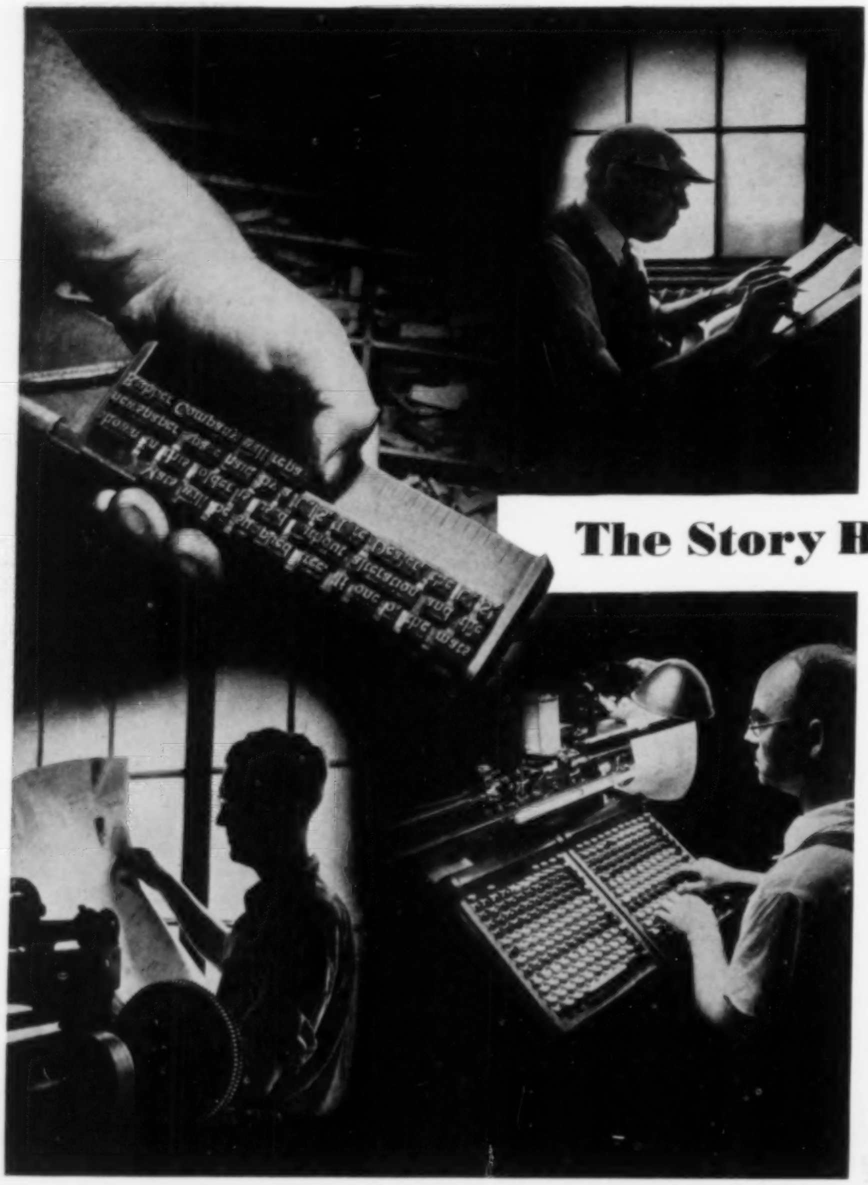
WHEN Allied troops took the Island of Sardinia, they fell heir to coal mines in Carbona, a modern town that was built in 1937-38 as one of Mussolini's projects. The mines are now being worked by native labor under the direction of the mining division of the Allied Control Commission, about 7000 of the town's 20,000 inhabitants being thus employed. The coal is used in Sicily and Italy as well as in Sardinia and is relieving the Allies of the necessity of shipping fuel into the area. The machinery found in the mines is chiefly of German design. One miner is using an air-operated coal pick, while his companion is wielding a hand pick.

●

WHEN the hydraulic braking system of a Liberator B-24 bomber was shot away during a raid over Germany, the crew had to figure out a way to stop the big plane within the length of the available runway upon its return to its home base in England. Yankee ingenuity solved the problem by improvising air brakes that made use of the drag of open parachutes. The chutes were fastened inside the plane and let out of the waist window just before the wheels touched the ground. As the picture below shows, the bomber was stopped without a mishap.



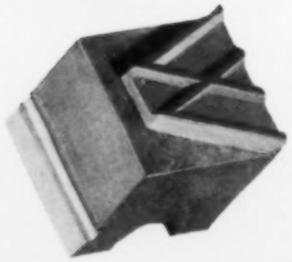
Official photo
U. S. Air Forces

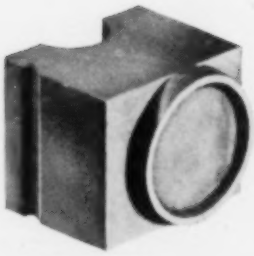


TYPE IS THE PRINTER'S TOOL
A photo montage showing a few of the numerous operations required to transfer words from manuscript to printed page. At the upper left, a compositor is holding a printer's "stick" partly filled with hand-set type. In the background is a case of type. This tedious method of composition has now been largely supplanted by typesetting machines in which type is formed of molten metal. The keyboard of a Monotype is shown at the lower-right. At the top-right is pictured a proofreader, and in the opposite corner is seen a pressman inspecting a printed sheet.

The Story Behind All Stories

J. F. Nesbitt





JOSEPH DUNNINGER, self-styled master mentalist, has baffled scientist and layman alike with feats of mind reading and telepathy—feats performed in many instances when considerable distances separated the principals in the demonstration. Cases of this unusual ability have occurred at rare intervals in the history of mankind and, depending upon the era in which the possessor lived, thought transference has been variously associated with witchcraft, magic, chicanery, and the supernatural. Science can offer no logical explanation of the phenomenon or the forces involved, and telepathy still remains a mystery. Dunninger contributes nothing when he avers that his performances could be duplicated "by a child of three—with thirty years' experience."

At the same time, we're not the least bit awed by the idea of thought transference through the medium of audible sound. That is one of the accepted facts of our every-day existence, although the means of its accomplishment—the larynx and the ear—are as miraculous and inexplicable as life itself. Through them we can enjoy the interchange of ideas in conversation and the mental stimulus of the lecture, sermon, drama, oration, or after-dinner speech.

But in his slow, ponderous march through the ages, man long ago recognized the inadequacy of audible speech. He set about devising his own method of communicating his thoughts to his fellowman—a method which had its beginning many centuries ago when he scratched crude figures and symbols on slabs of stone. He had a symbol for the sun, a symbol for the moon, a symbol for man, a symbol for his dinosaur beast of burden. These, though limited in number, were sufficient to cover the range of his cryptic vocabulary and primitive intelligence.

As the human race added to its culture it added to its symbols, eventually developing the alphabet, combining the letters to form words, and grouping the words to achieve graphic presentations of ideas. The stone tablet was discarded when parchment was invented; the stone hammer and chisel gave way to paint and brush. These, in turn, lost their usefulness with the coming of hand-carved wooden letters which were followed, in successive steps, by ink, the printing press, metal type, and typesetting machines.

Today the printed page, in its myriad forms, has become a most important adjunct to our modern way of life—a personal contact with the world beyond our individual horizons—a companion of leisure moments to comfort and amuse—a tutor always ready when summoned—a treasure to be guarded for posterity in archive or library. It is thus modern civilization propagates and perpetuates its culture and religion—the glory of its arts, science, and philosophy.

Some of us read slowly, concentrating on the meaning of each word, while others skip rapidly from phrase to phrase, but all are so absorbed in the thought unfolding before our eyes that we do not see the very thing we are looking at—the type. It is like the shopper gazing at the wares on display in a shop window, totally oblivious of the plate glass through which he is looking.

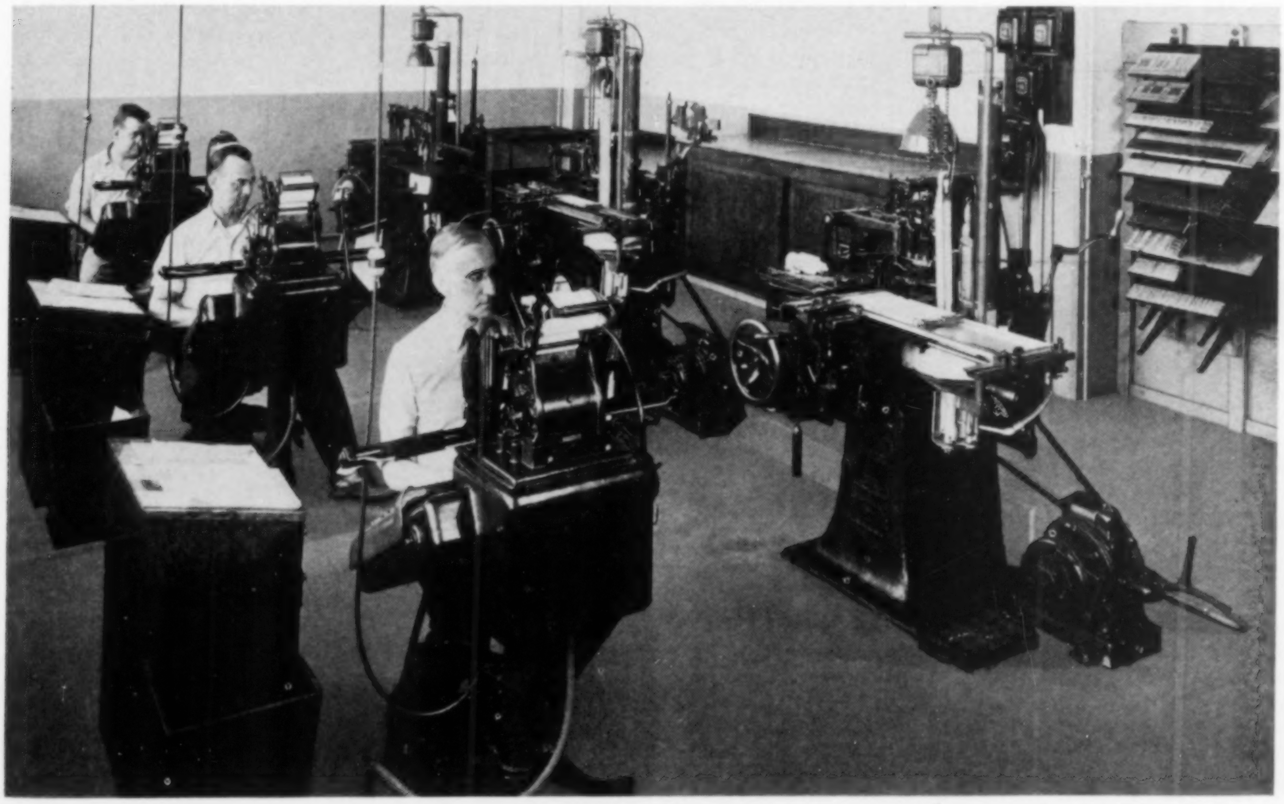
You probably haven't noticed that the words you are now reading are set in a different type face than the book you may have perused recently or the advertisement that may have attracted your attention. Do you ask why? There is no one all-inclusive answer. Just as the artist may choose a particular shade of green for his landscape painting, so the selection of a suitable type face may depend upon the judgment of the typographer—upon his sense of its fitness in relation to the subject matter or theme—upon his conception of the requirement of the general layout, the width of the column, the number of words to be used in the space available, or the proper balance between the various elements that constitute the layout.

There are approximately 1500 type faces in more or less extensive use: old-style faces suitable for books and magazines because they can be comfortably read over long periods; modern faces admirable for works or treatises of a scientific or technical nature; faces especially adapted for advertising; faces for decorative purposes; faces for display. All can be grouped in a few easily recognizable classifications—roman, italic, script, and gothic, with such subdivisions as serif, sans-serif, bold- and lightface.

The largest and most important of these is the roman. Here we have a vast number of individual styles of lettering dating from the middle of the fifteenth century to the present day. Differences in their character and design, hardly apparent to the untrained eye, enable the expert to place them in three major categories: old style, transitional, and modern, based on the historical progression or trend of typographic design. The old-style faces, which are patterned after letter forms of the early master printers, are distinguished by a comparative roundness of form, uniform thickness of lines, and freedom from stiffness or mechanical restraint. Cloister Old-style is typical of a group that traces its origin to the early Venetian types of which the letter cut by Jensen in 1470 is the best known.

The type named after the sixteenth century French typographer Garamond is typical of another group of old-style romans. Unlike Jensen, who copied a manuscript style, Garamond designed type, freely interpreting rather than copying pen forms. Still another and later old style is exemplified in Caslon, which first made its appearance in England in 1734. Influenced by earlier Dutch models, it has a smooth-reading quality that has made it the world's most popular type—a pattern for practically all the ordinary body types used in printing today.

The outstanding example of the modern romans is Bodoni, which closely fol-



MONOTYPE MACHINES

The "Mono" room in which was set the type that printed the words you are now reading. The machines at the left are keyboards. As the keys are depressed, each cuts a paper stencil in the manner of a record for a player piano. When the stencil is transferred to one of the casting machines at the right it automatically controls the casting of the type. Two operations are necessary here, whereas in the case of a Linotype, keyboarding arranges metal matrices for each line. This is immediately cast into type, after which the matrices are automatically distributed to their original channels. Monotypes, both keyboarding and casting machines, use compressed air in their operation.

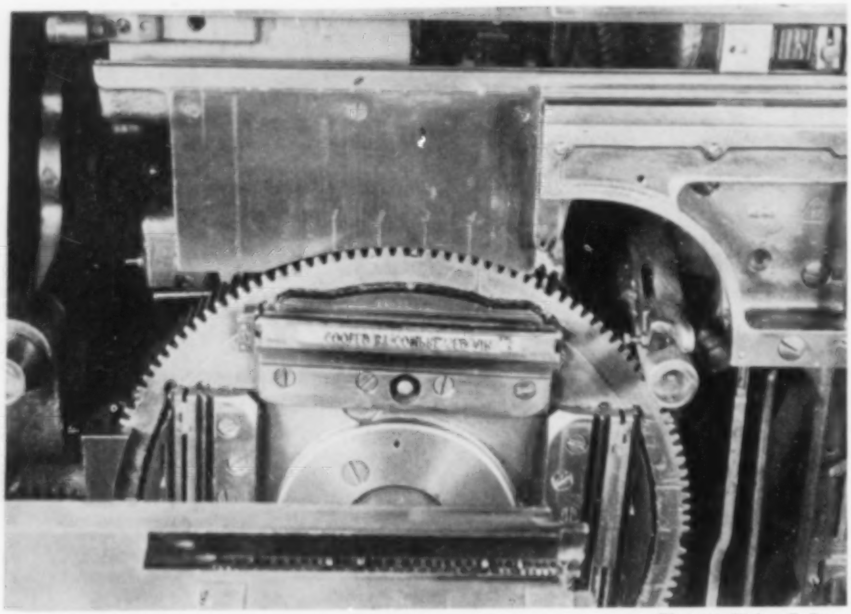


Photo by Walter C. Frye

DETAIL OF A LINOTYPE

The Linotype machine, as its name implies, casts a line of type at a time. It is almost universally used for newspaper typesetting, whereas the Monotype, which casts each character separately, predominates for setting text for books and magazines. This picture shows the mold wheel with a line or "slug" of type set up to print the words, "cooled by compressed air." The type metal is heated to 500-525°F., and the mold wheel gets very hot, especially when large type is being cast. It is cooled by blowing compressed air on it, the delivery pipe being at the right of the wheel.

lows the style of letter originated by Giambattista Bodoni at the end of the eighteenth century. In comparison with the old-style faces, this type is characterized by strong contrast of stroke, with almost mechanical sharpness and precision.

Since the limits of such a grouping can never be exactly defined, there are the transitional faces which are neither old-style nor modern but which have many of the distinctive features of both Scotch Roman and Century Schoolbook (the type in which this article is printed). These are probably the best examples, combining the softness and flowing qualities of the old style with the orderliness and regularity of the modern.

Contemporary developments in design have produced a variety of new types, differing widely in their characteristics and having little resemblance to older, established forms. This group of ultramoderns, the result of the broader creative latitude brought about through the discovery of many new reproduction processes, will take its place with the others as a natural step in the continuing growth of modern typography.

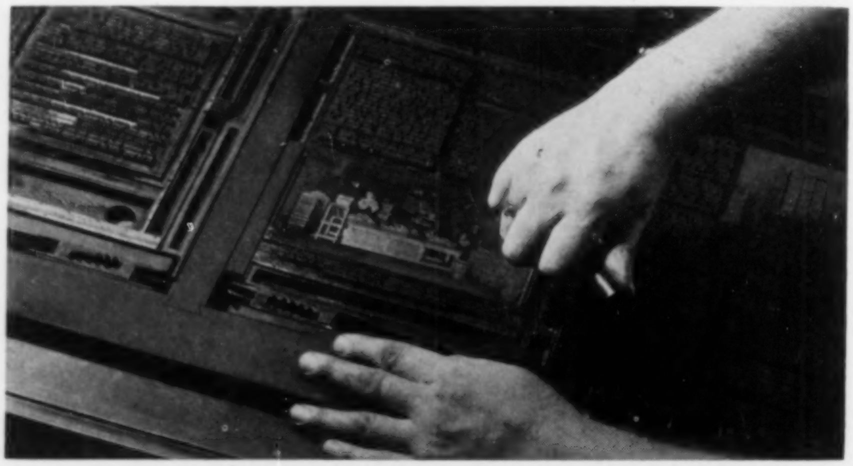
Type, which one usually thinks of merely as the characters composing a printed word, is really the faithful reproduction of carefully designed lettering. It is closely allied to the fine arts and, in common with music, painting, and sculpture, has its masterpieces as well as its short-lived fads and mediocrities. Many faces were designed to improve the legibility of the printed page; others to enhance its beauty. Many were originated to suit the whim or to express the personality of the artist; others just to create something different. All, in a greater or lesser degree, reflect the taste and feeling of their time.

Prior to the advent of the printing press and the invention of movable type by Gutenberg in the early part of the fifteenth century, all manuscripts and books were lettered by hand. Subsequently, master typographers in Italy, France, Spain, Holland, and England adapted the styles of lettering used by the scribes to the needs of the new process. As printing developed, they began to improve on the old forms of manuscript lettering, creating such new designs as their artistic ability or genius dictated.

Printing in the early days was a slow, painstaking craft to which men devoted their lives—setting type and operating their presses entirely by hand. The fruit of their efforts was a luxury patronized solely by the upper classes and was often valued for itself as much as for the thoughts it conveyed. Today, the quickening tempo of modern life, the broadening influence of civilization's phenomenal advance, and the encroachment of new and varied interests have conspired to transform printing from a leisurely art to a medium of quick convenience for the masses.

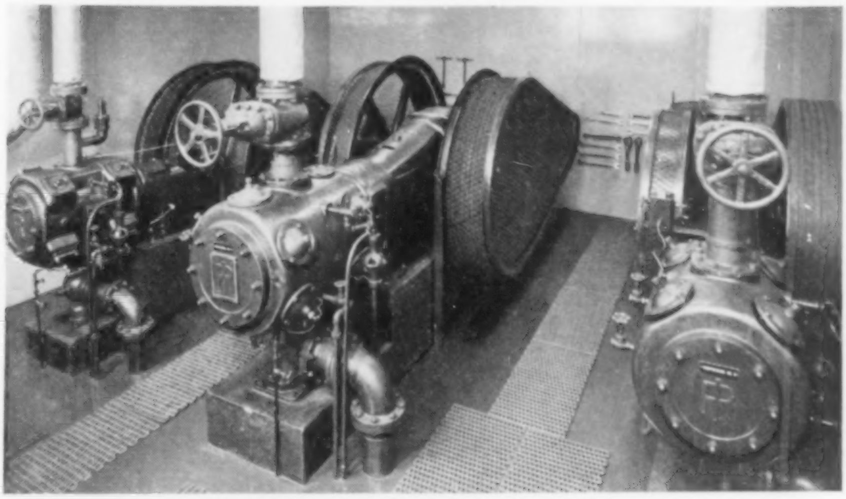
High-speed rotary presses, automatic flat-bed presses, gigantic color presses, and rotogravure and offset presses turn out printed matter in a never-ending stream, while production in the composing room has been stepped up by machinery to meet the demands of those pace-setters. Typesetting and casting machines—Linotype, Monotype, Ludlow—turn out type in quantities of truly astronomical proportions.

In a sophisticated world, reading-hungry and thirsty for knowledge, type is taken for granted and is generally regarded as a means to an end. Unheeded and without the stimulus of popular acclaim or recognition, the typographic designer still carries on in the true traditions of his highly specialized art, his genius the root from which the industry will derive its future vitality and strength.



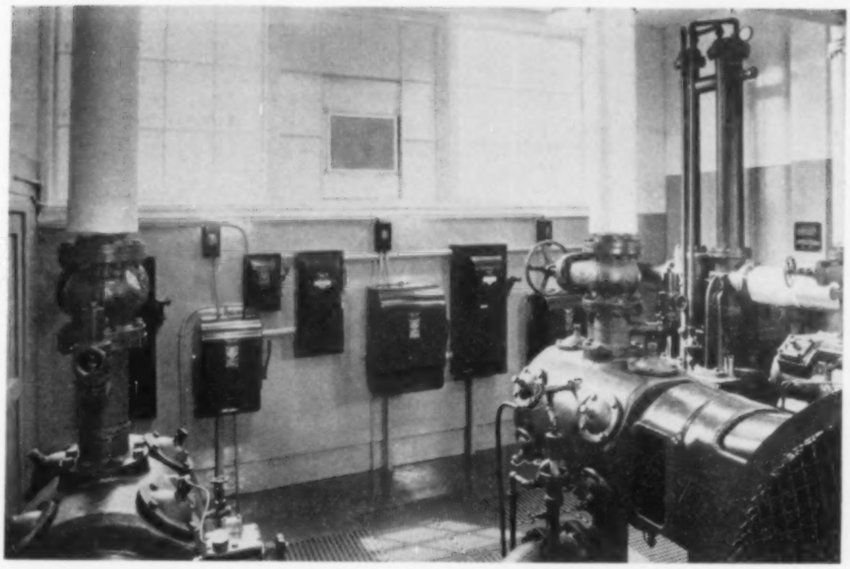
LOCKING UP A FORM

A "lock-up" man using a quoin key to secure a series of pages in a metal form or chase for printing. The wedge-shaped pieces of metal at the edges are the quoins, and these have recesses in the center by means of which they can be moved by turning the key, thus bringing pressure to bear against the edges of the type form and holding the pages in place. The entire form, consisting of up to sixteen pages, can then be lifted and moved to a flat-bed printing press.



COMPRESSOR ROOM

The three machines that serve the foundry with air are seen at the right. Note the spick-and-span appearance, the rubber matting on the painted floor, and the wrenches arranged in order on the wall. The picture below shows the opposite wall of the compressor room with the switch-box controls, each of which bears a label explaining exactly what it is for.



Foundry Air Conditions Compressor Plant

Leo H. Long

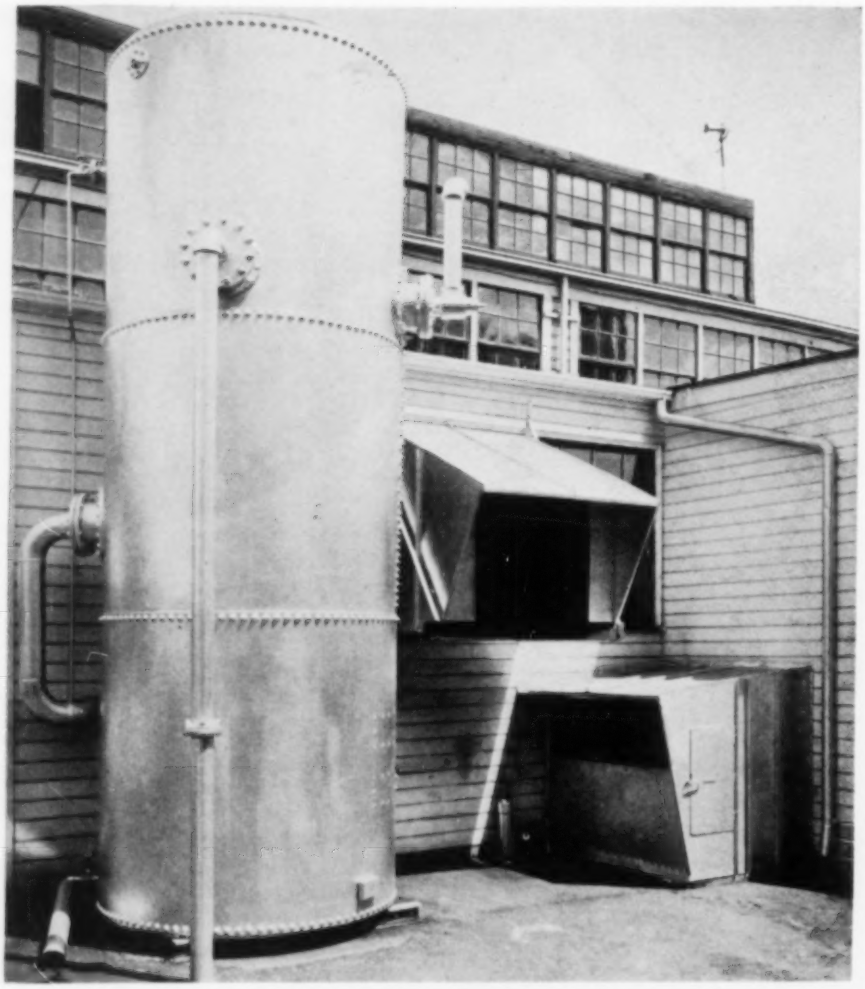
THE Atlas Foundry & Machine Company, of Tacoma, Wash., is one of the most modern and complete establishments of its kind on the Pacific Coast. It was founded in 1899 by John Hartman, and was incorporated two years later. From the start it has been a jobbing foundry, and its castings have contributed importantly to the industrial growth of the Northwest. Foremost among its customers have been the logging and lumbering concerns, the fisheries, and the railroads, although numerous other lines of endeavor have made use of its diversified products. Since the war began, the greater percentage of its output has gone to shipyards for inclusion in merchant vessels and naval craft.

The company's physical plant and facilities have been gradually expanded as need for additional services arose, and now the foundry is one of the few on the Pacific Coast that are equipped to supply almost any type of casting that may be required in the territory it serves. It casts iron, steel, brass, aluminum, and various alloys. The steel foundry has two Lectromelt, top-charge, electric furnaces with a combined capacity of 10 tons per heat and 40 tons per day. These regularly supply metal for pouring castings ranging from 1 pound to 6 tons in weight. In the iron foundry, which is served by a 42-inch and a 30-inch cupola, castings up to 15 tons can be made. For nonferrous work there are five furnaces which can melt bronze at the rate of 4000 pounds per hour. The pattern shop is claimed to be the most modern and best arranged on the Pacific Coast. The lighting equipment leaves little to be desired; there is an underfloor exhaust system for removing sawdust from the air; and patterns are stored in fireproof vaults.

The foundry is on the main line of the Northern Pacific Railway and is laid out to handle materials efficiently. Craneways run parallel to the railroad, and there are warehouses on both sides of a spur line where incoming raw materials are unloaded, tested, and stored until they are needed. The laboratories include complete facilities for making physical and chemical tests, as well as X-ray equipment for examining finished castings.

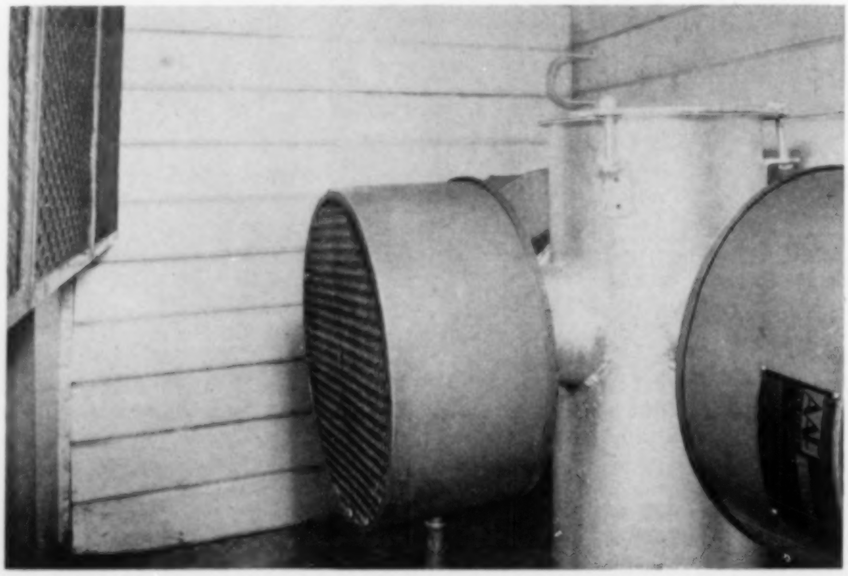
In line with its policy of keeping the plant abreast of the times, the company has recently introduced in its compressor room what is perhaps an innovation in the foundry industry. Not only is all the air entering the compressors filtered twice, but the room in which the three machines are housed is kept under slight positive pressure to prevent dust from seeping in through openings around doors and windows. In addition to making sure that no damaging grit will get into the compressors, this conditioning of the air serves to keep the room cool in the summertime. Although similar means are employed in at least one oil-field compressor plant in the dust-bowl area of west Texas, this is believed to be the first instance of their use in a foundry.

Outside air is drawn into a separate room before going to the compressors, being passed through filter sections set in the wall and placed near the ground where the air is coolest. Within the room



FILTER ARRANGEMENT

The exterior view above shows the two air intakes, both of which are equipped with standard filter panels. The bottom one leads to a separate room adjacent to the compressor room and through it passes the air that goes to the compressors. The upper intake feeds a blower that keeps the compressor room under a slight positive pressure to prevent dust from entering. At the left is the receiver through which the compressed air passes on its way to the foundry building. At the bottom is an interior view of the filtered-air room. The intake from the outside is seen at the left. At the right are three filters that again treat the air going to the compressors.



are additional filters on the intakes of a header that supplies air to all three compressors. The compressor room is kept under a few inches of water pressure by a blower, which also receives its air supply through a filtered intake in a wall of the building.

The interior walls of the compressor room are covered with white enamel and the floor is painted Indian red. To prevent it from being marred by foot scratches, strips of rubber matting are laid around the machines. The place is vacuum cleaned once a week as a further safeguard against the accumulation of dust. It is the boast of the maintenance department that white gloves worn while performing routine operations in the compressor room will not get dirty.

The three compressors are all Ingersoll-Rand straight-line, single-stage, belt-driven units. Two of them have 12x10-inch cylinders, and each has a piston displacement of 368 cfm. The third machine, which was recently added, has a 14x13-inch cylinder and a piston displacement of 628 cfm. The combined piston displacement is 1364 cfm. An Ingersoll-Rand vertical aftercooler serves all three units and extracts moisture from the compressed air immediately after it is discharged. The air then goes to an 8x25-foot outdoor receiver, from which the delivery line to the foundry takes off. A 3-inch distribution line runs along each side of the foundry building and is so long that it adds materially to the storage capacity. Outlets extend from the 3-inch lines to the various molding stations.

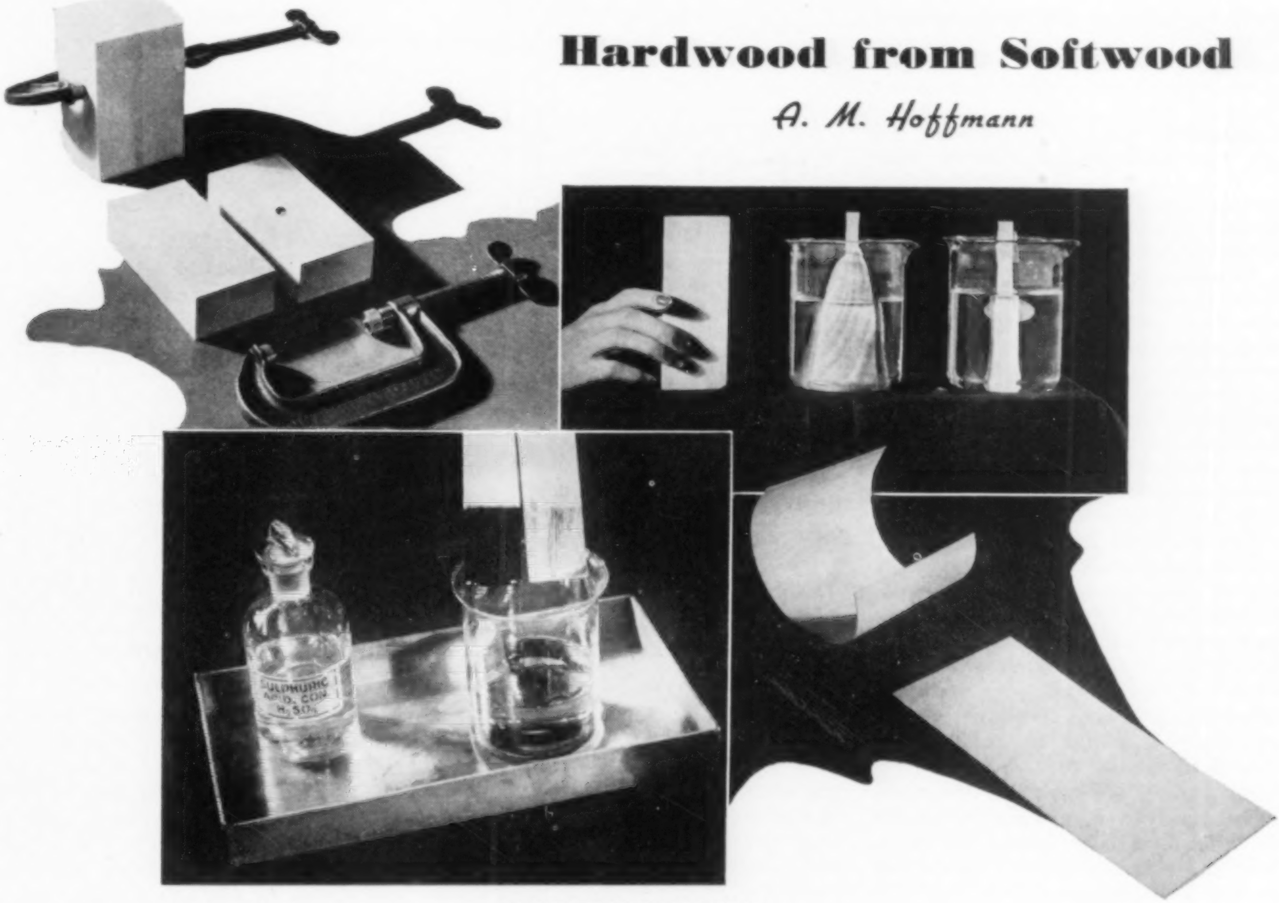
A thermostat on each compressor controls the temperature of the cylinder-jacket cooling water. If a cylinder becomes overheated, electrical connections and relays cause a bell to ring outside of the compressor room and turn on a red light which indicates which machine is affected. Each electric switch in the compressor room bears a tag explaining just what function the switch performs, thus greatly reducing the possibility of error on the part of inexperienced help. The room is kept locked and only authorized persons are permitted to enter it.

One of the motives of the management in setting up this model compressor plant was to provide an example which, it was hoped, would induce the maintenance department to keep all foundry equipment reasonably clean and in proper operating condition. The desired end has been achieved, as there has been no production delay through breakdown since the improvements were made.

The Atlas Foundry & Machine Company was purchased in 1929 by the Long family, which has operated the plant since then. Joseph L. Long, Sr., is president and Mrs. Long is vice-president. Joseph L. Long, Jr., is secretary-treasurer, and the writer is superintendent.

Hardwood from Softwood

A. M. Hoffmann



COMPARATIVE TESTS

In the right-hand block of untreated wood in the picture at the top-left is a deep dent, showing that it is much softer than the paralleling treated piece on which barely a mark was left by the clamp. Alongside are specimens of balsa wood immersed in water to test their dimensional stability. Both were compressed to a thickness of about ¼ inch from blocks such as that at the left. The untreated piece (center) swelled; the impregnated wood remained substantially unchanged. Below, left, are two strips of wood which have been dipped simultaneously in sulphuric acid to demonstrate the difference in chemical resistance between the natural (left) and the transmuted product. At the right are two sheets of veneer that have been placed on a wet Turkish towel to determine their resistance to warping. The treated ply has remained flat; the other has curled up considerably.

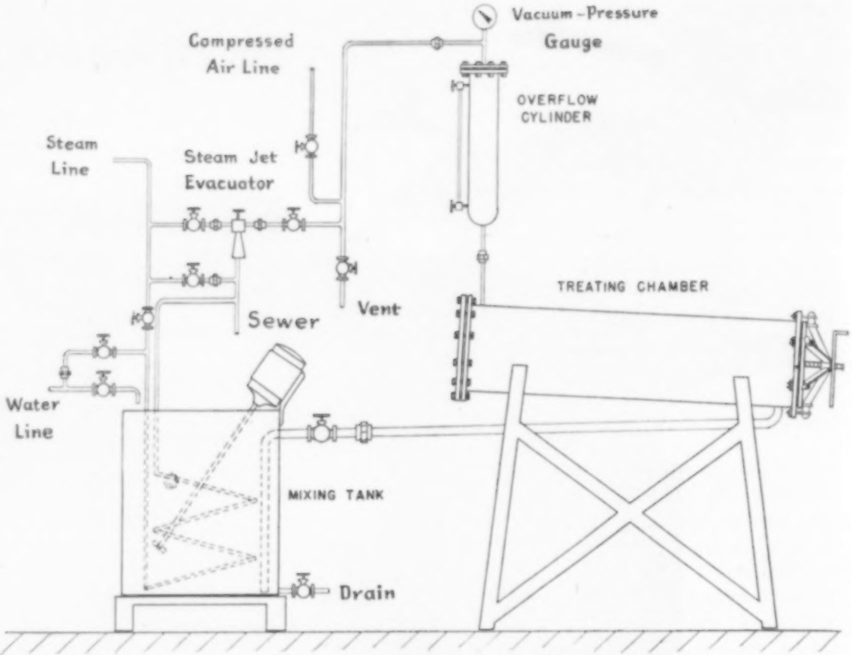
WE ARE informed that the United States grows about 50 species of wood that have extensive commercial application, but that there are 1000 and more that do not reach the manufacturer and the builder because they are too soft, crush or dent too easily, and present turning, working, and finishing difficulties. As most of us know, the chemist has done much to endow wood with properties that have greatly extended its field of usefulness, but now we are told that he has gone a marked step forward by developing a method of resinification that promises to convert not only the acceptable but also the undesirable, fast-growing varieties into materials that can compete with plastics and metal.

The process is the result of years of research by the U. S. Forest Service, E. I. du Pont de Nemours & Company, and others; and, although it has but lately emerged from the laboratory, the data obtained indicate that it is commercially practicable. The equipment required is not new and has been used successfully for years in creosoting timber and otherwise impregnating it with preservatives; but one of the constituents of the chemical by which the wood is given fundamentally different properties has only recently been made available on an industrial scale. It is dimethylolurea, which is combined with urea to form methylolurea.

The so-called "full-cell" or vacuum-pressure method of impregnation is considered most suitable for the purpose because it insures evacuation and filling of the cellular structure. Before treatment, the wood is dried well below its fiber-saturation point so that the flow of the solution and its diffusion throughout the cell walls will not be impeded. Cut as near as possible to finished form rather than in rough blanks, the material goes into the pressure chamber in bulk or, in the case of small articles, in bundles or baskets. This increases the capacity of the cylinder and conserves chemicals. As wood expands under impregnation, allowance for this has to be made in charging the chamber.

Withdrawal of the air from the cylinder is effected by a steam-jet ejector or a vacuum pump, which also serves to draw the chemical from a nearby mixing tank into the cylinder through a bottom opening. Enough methylolurea solution is introduced to allow for absorption and to keep the contents covered throughout the treatment period. This is made possible by the use of an overflow cylinder fitted with a sight gauge. At this stage of the process suction is broken and compressed air is applied at a pressure not exceeding 100 pounds per square inch for most purposes and for periods of from 10 to 50 minutes, depending upon the desired depth of penetration. With impregnation finished, the left-over chemical is forced back into the mixing tank by compressed air for reuse; pressure in the system is vented; and the wood is removed from the chamber for drying.

Both complete and partial impregna-



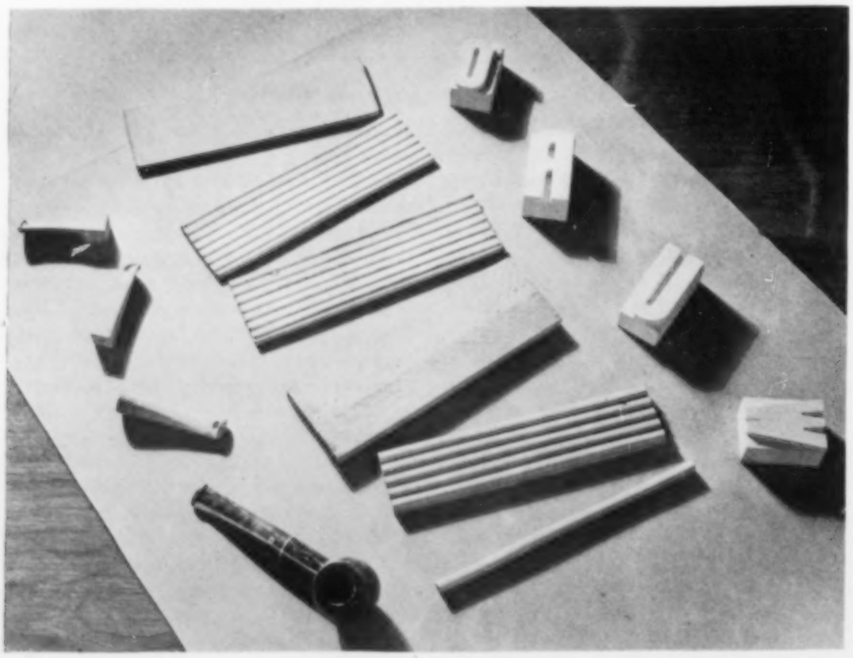
GENERAL LAYOUT OF IMPREGNATING EQUIPMENT

tion are resorted to. The first is essential in the case of veneers, furniture, parts for textile machinery and farm implements, sports goods, musical instruments and a long list of other fabricated articles. Logs, piling, building lumber, and the like are case-hardened—that is, they are given a hard, high-strength shell that enables them to take heavier loads or permits lighter construction, leaving a softer, tougher core to resist impact.

According to J.F.T. Berliner of the du Pont Company, the methylolurea is converted into resin by the natural acids present in the wood. It enters as a water-soluble, uncondensed material; but the wood acids, plus heat such as is applied in normal kiln-drying, or air-seasoning for the customary length of time, change it into an insoluble but fusible resin. Over a period of time, or if subjected to elevated temperatures for a short while, the resin is converted into the infusible state. When the wood is molded under pressure and at a temperature of 240°F. or higher, the resin will melt and flow and become infusible. In consequence, the finished product shows a markedly reduced tendency to dimensional changes when exposed to water or moisture at moderate temperatures. This characteristic of the resin to fuse under heat and pressure is of advantage in making plywood, for when the veneers are adequately impregnated and dried, they are self-bonding—the resin itself serving as the adhesive.

Wood treated by the new process may be compressed to any desired specific gravity up to about 1.4, producing a hard, strong, close-grained product that requires no filling. If polished or embossed platens are used on the presses, the surface of the wood will be polished or embossed. The material has less tendency to shred and splinter during sawing, planing, and turning, and has increased resistance to flame, most chemical agents, fungi, rot, and pest infestation. The resin does not affect the natural color of the wood; but dyes may be introduced with the chemical. For instance, a light pine or poplar may be given the appearance of cherry, rosewood, or mahogany, or it may be dyed red, blue, green, or any other color to meet personal fancy. The commercial practicability of the process has been established by small-scale tests, and a number of manufacturers are already prepared to make use of the treatment. However, as there are many kinds of wood and each species differs in structure and grade, the treatment in each case will have to be determined through plant tests. Sapwood of both soft and hardwoods, as well as the heartwood of a number of species, can be impregnated.

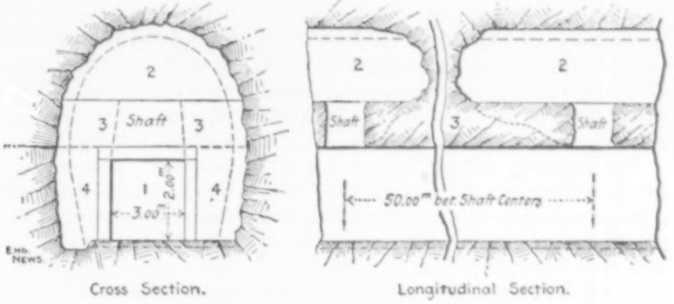
Faced as we are with a lumber shortage largely because the war has considerably reduced our stands of trees that have commonly found their way into the sawmill and thence into the factory and the building trade, the newest chemical development is of especial significance. There are about 180 million acres in the South covered with pine, and this is only one of the hundreds of softwoods that may be changed and used for purposes for which they are not suitable in their natural state. Soft maple, tupelo gum, and yellow poplar are others that may be converted to do the work of hard maple, oak, walnut, etc., which, in turn, may be improved to the point where they can substitute for plastics and even for ebony, which is the hardest of the well-known woods. In short, wood can be chosen for its grain, color, and natural beauty regardless of its inherent weaknesses, thus measurably increasing the nation's supply.



PRODUCTS

Here are parts of pipes, pencils from the raw to the finished stage, and type made of chemically treated softwood that would not be suitable for their manufacture in its natural state.

Echoes of the Simplon Tunnel

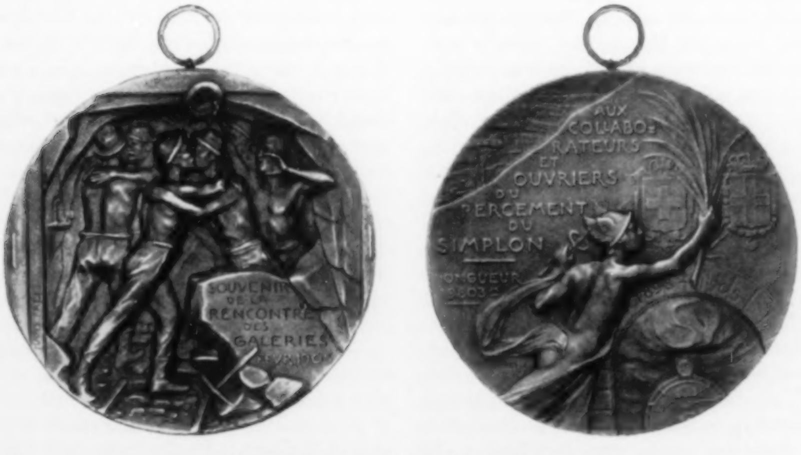


SEQUENCE OF EXCAVATION

A bottom heading, 1, was first excavated and timbered. At intervals of 50 meters (164 feet) raises were driven to the top of the tunnel line and crews worked both ways from these to excavate area 2. Sections 3 and 4 were then removed in that order and the lining was placed. In carrying out these respective operations, much timbering had to be set in bad ground.

IN AN account of the holing through of the Alva B. Adams Tunnel in our July issue, reference is made to "the Simplon in Italy" as previously having been the longest bore ever driven from two headings. This brought a letter from A. T. Hurter of the Canadian Car & Foundry Company, Limited, at Montreal, Que., informing us that, although one end of the Simplon is in Italy, the greater part of it lies in Switzerland. Mr. Hurter came from the Swiss district in which one end of the bore is located and recalls with pardonable pride that the tunnel was constructed entirely by a Swiss engineering firm. He was present at the holing-through ceremonies in 1905 and still has in his possession a bronze medal that he received as a souvenir on that occasion. Through his courtesy we are able to present the accompanying illustrations showing both sides of the medal.

Mr. Hurter also informs us that trains are drawn through the Simplon Tunnel by a 12,000-hp. electric locomotive, the largest railway traction unit ever built. It was manufactured by a Swiss concern, Ateliers de Construction Oerlikon. It contains sixteen motors and attains a maximum speed in service of 70 miles an hour. The maximum tractive effort is about 143,000 pounds. In order to utilize this force it is necessary to increase the weight on the driving wheels from 160 to 172 tons, and this is done by taking weight off the middle free axles by means of a compressed-air weight reducer. The locomotive will haul trains of 770 tons (excluding its own weight) at a speed of 46.5 miles per hour up the 2.7 percent maximum grade of the Gothard line of the Swiss Federal Railways. It is a double, articulated unit with an over-all length of nearly 112 feet. The motors are arranged transversely in the locomotive and work in pairs. Eight driving-axle sets are required so that the aforementioned output can be developed. The locomotive operates on single-phase current of 15,000 volts and a frequency of 16⅔ cycles per second drawn from an overhead wire by two pantographs. Twenty-nine speed-regulating steps are provided, with all essential parts submerged in oil.


SOUVENIR DE LA RENCONTRE DES GALERIES
AUX COLLABORATEURS ET OUVRIERS DU PERCEMENT DU SIMPLON
LONGUEUR 19803
1898
1905

SOUVENIR OF HOLING THROUGH

Photographs of the two sides of a bronze medal that was given in commemoration of the joining of the headings of the tunnel in 1905. The inscription on the one side, left, reads: "Souvenir of the meeting of the galleries. February 1905." That on the reverse is as follows: "To the collaborators and workers who drove the Simplon. Length 19803 meters. 1898-1905."

Our interest in the Simplon Tunnel having been aroused by Mr. Hurter's letter, we were prompted to look further into the literature describing its construction. This research impressed us with the fact that, although the art of tunneling through rock has made significant advances during the intervening years, the driving of the Simplon was a marvelous piece of work for its time. In fact, many of the devices and facilities found on modern tunnel jobs were in use on that bore.

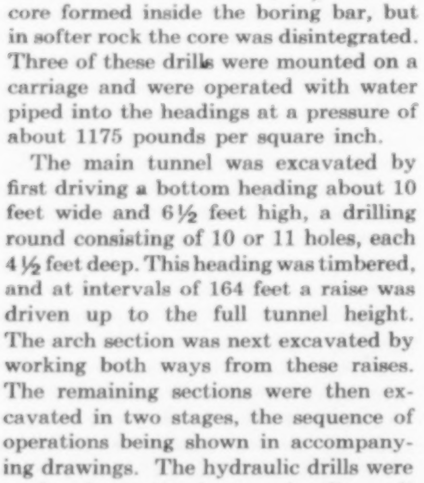
The Mt. Cenis, St. Gotthard, and Arlberg transportation tunnels through the Alps resulted in a gain in trade by Italy, Switzerland, and Germany at the expense of France. This could be offset only by a more direct line between France and Italy; and after many possible tunnel sites in the Alps had been investigated, the Simplon route was selected even though it called for a bore 12.4 miles long. Treaties permitting its construction were signed with Italy and Switzerland in 1895, and the Italian government agreed to build a connecting line to link the bore with its existing rail system. In 1897 the Jura-Simplon Railway Company awarded a contract for the construction of the tunnel to Brandt, Brandau & Company of Winterthur, Switzerland. Work was started on November 13, 1898; the bore was holed through on February 24, 1905; and the first train ran through it on January 25, 1906.

The Simplon extends from Brig, Switzerland, to Iselle, Italy; is 65,734 feet long; and cost $15,700,000, or $239.40 per linear foot. The Swiss portal is at an elevation of 2246 feet, and the line ascends on a grade of 0.2 of 1 percent to a high point at Elevation 2310, descending on a grade of 0.7 of 1 percent to the Italian portal at an altitude of 2076 feet. The tunnel was driven with the aid of an auxiliary bore paralleling it at a distance of 56 feet. The two were connected at intervals of 656 feet, and the auxiliary was used for drainage and to improve ventilation. The main tunnel was lined with masonry to a finished cross section of 16.4x19.5 feet, the section excavated depending upon the character of the ground penetrated and ranging up to 25x31 feet. The auxiliary bore had a cross section of 9.5x6.5 feet.

The engineer Brandt had invented a rotary hydraulic rock drill that had been used at one end of the Arlberg Tunnel fifteen years previously, and drills of this type were employed at both of the Simplon headings. The boring bar, as it was called, was rotated by two cylinders and was fed into the rock by another cylinder. The maximum speed was 10 rpm. The cutter head at the end of the boring bar had an outside diameter of 3 inches and an inside diameter of 1½ inches. Water was fed through the boring bar and cutter head to wash cuttings out of the holes. In very hard rock a core formed inside the boring bar, but in softer rock the core was disintegrated. Three of these drills were mounted on a carriage and were operated with water piped into the headings at a pressure of about 1175 pounds per square inch.

The main tunnel was excavated by first driving a bottom heading about 10 feet wide and 6½ feet high, a drilling round consisting of 10 or 11 holes, each 4½ feet deep. This heading was timbered, and at intervals of 164 feet a raise was driven up to the full tunnel height. The arch section was next excavated by working both ways from these raises. The remaining sections were then excavated in two stages, the sequence of operations being shown in accompanying drawings. The hydraulic drills were used only in the bottom heading, all other drilling work being performed by hand.

Blasting was done with dynamite, an average of six 1-pound cartridges being required per hole. Firing was done with fuses. Muck was hand loaded into narrow-gauge cars, which were drawn back from the heading by horses. Approximately 650 men and 29 horses were employed at the Swiss end and 500 men and 16 horses at the Italian end. An average heading crew consisted of 14 or 15 men. The horses pulled the laden muck cars a short distance, and when enough were available a train was made up and hauled back toward the portal by a compressed-air locomotive. The final stage of the hauling was done by a steam locomotive.



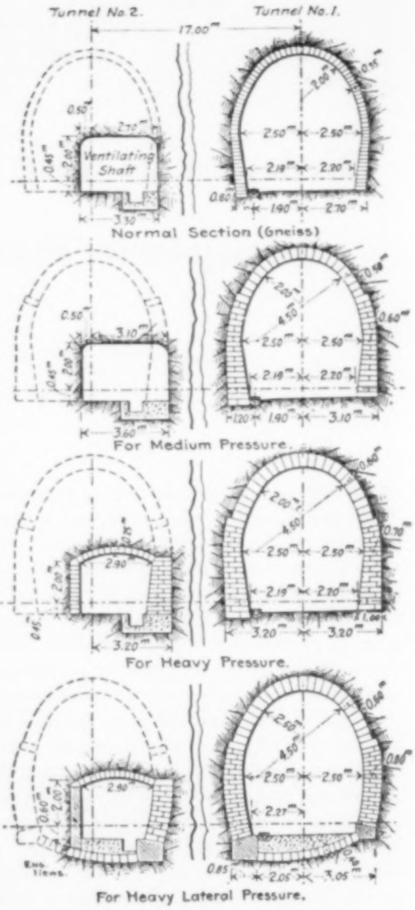
LINING IN HEAVY GROUND

An idea of the enormous amount of work involved in some sections is given by this sketch. The floor or invert was lined first, then the side walls and, last, the arch.

By these methods, and working three 8-hour shifts daily, the crews advanced at an average daily rate of 13.69 feet per heading. The rock was principally gneiss, with occasional stretches of slate, granite, and marble. This progress was undoubtedly very good considering the difficulties encountered. Heavy flows of water were struck, and some of it was hot, resulting in tunnel temperatures as high as 131°F. In May, 1904, the Swiss heading had to be abandoned because of too much water, and the final section was completed from the Italian side, but under such adverse conditions that it took six months to excavate the last 800 feet. After a hole was finally punched through the two headings, the rock was so hot that the official inspection trip had to be delayed a day to permit the circulating air to cool the atmosphere to some extent. As it was, two members of the inspection party died. Air for ventilating the workings was piped in from the portals, at each of which there was a fan driven by a 200-hp. turbine. In addition, cold water, obtained from the Rhone River on the Swiss side and from springs on the Italian side, was conveyed into the tunnel by a 10-inch pipe placed inside a 16-inch pipe, the annular space being filled with charcoal for insulation. This water was sprayed at the headings in an effort to counteract the extreme heat.

Primary power was supplied at both portals by water wheels. The water was piped from the Rhone and Diveria rivers. On the Swiss side there was a 2200-hp. installation and on the Italian side one of 1100 hp. Through shafting, Pelton wheels drove various machinery, including plunger pumps that fed water under pressure to accumulators and thence into the pipes that extended to the hydraulic drills at the headings. One of the air compressors used was made in the United States by Ingersoll-Sergeant Drill Company.

Illumination in the tunnel was provided by gas lights at one end and miners' oil lamps at the other, although electricity was available at both portals for lighting yards and buildings. In addition to electricity, numerous other conveniences that are generally considered of modern origin were found in the camps where the men were quartered. The drinking water was filtered, and at each portal there were dry rooms, each containing 80 bathrooms that were heated in the wintertime by steam pipes to 71°F. Change rooms were equipped with individual locking chains that permitted miners to elevate their clothes out of reach, as is done today at mines and construction camps. Houses were provided for married workmen and engineers. For unmarried engineers there were boarding houses, with clubrooms and reading rooms. Other facilities included a laundry for the engineers' clothes, and an ice-making plant. At each portal was a first-aid station with a surgeon and attendant always on duty, and each camp had a 40-bed hospital.

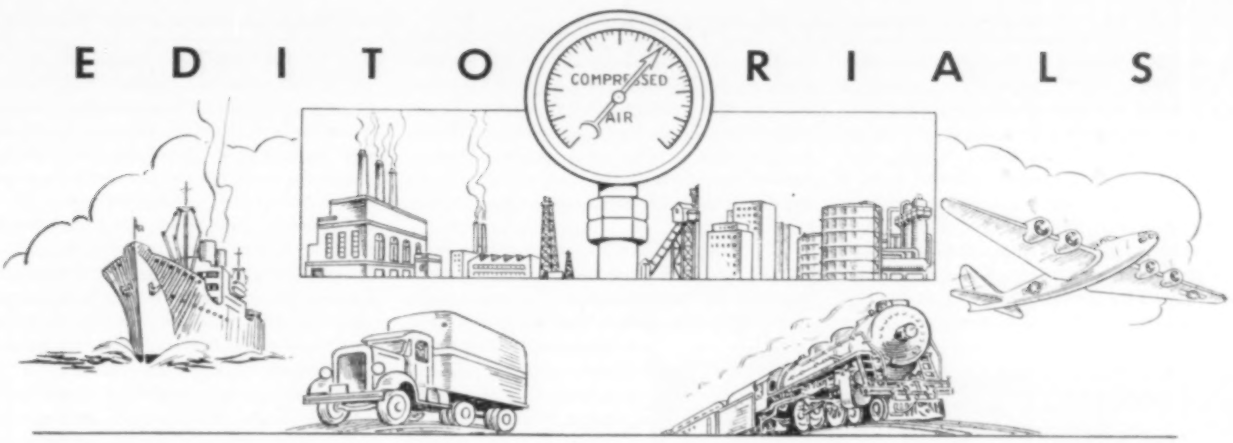


STANDARD SECTIONS

Here are shown variations in the lining in different kinds of ground. The sections at the right are of the large tunnel; those at the left, of the auxiliary construction bore which was later enlarged to full size.

Trains were temporarily run through the tunnel by steam locomotives until electrification could be carried out. Ventilation was effected by blowers at either end of the bore. Traffic increased rapidly, and by 1912 had reached a volume that led to the decision to enlarge the pilot bore. World War I slowed up the work, but the tunnel was completed in 1921 and put in service in 1922.

EDITORIALS



YOUTHFUL RAILROADERS

ONE of the pressing problems of the railroads right now is maintenance of track. More trains are pounding over the rails than in normal times, and they are longer and heavier laden. As a result, tracks require greater attention than in prewar times. The problem would not be serious if the railroads had ample labor crews, but they have lost many men to the armed forces and to war industries where pay checks are larger. Regardless of these difficulties, it is imperative that track be kept in condition to enable the railroads to move freight and passengers on time and with safety.

The Pere Marquette Railway cracked the maintenance nut during the summer by recruiting track gangs from high-school students. These boys are too young for military service, yet big and strong enough to do a good day's work after muscles have been attuned to their task. More than 200 of them put in the summer as track workers and are returning to school with extra pounds, extra dollars, and a knowledge of one of the fundamental operations of railroading.

Ever since Red Grange, the "galloping ghost" of Illinois football fame, hardened himself by delivering ice during the summer, it has been the popular thing for high-school and collegiate athletes to spend their annual vacations at hard labor. The Pere Marquette capitalized on this fact and enlisted its track workers among the boys of Grand Rapids High School who had aspirations to achieve fame on the gridiron or in other fields of sport. It wasn't hard to sell the boys the idea, especially when they learned that their coaches would go along and hold down supervisory jobs.

Quarters for the youthful track gangs were provided in boxcars, but an extra-special job was done in fitting them out. Bunk cars housed ten boys each, and were equipped with new and comfortable beds, tables for games, shower baths, and toilet facilities. In the foreman's car was a 200-volume library, loaned by the Grand Rapids Junior College, and desks for writing letters. The commissary and dining cars were modern in every way, and chefs were schooled to give the boys the sort of food they would receive at a college football training camp. During off hours, athletic competitions were held, and each boy was given instruction in the sport he favored. Sleeping hours were regulated, with lights out at 11:45.

Many of these "camps" were run through the summer, with mutual benefit to the railroad and the students. The project was approved by the Commissioner of the State Department of Labor and Industry of Michigan. Aside from the work done, the road feels that the venture was worth while because of the interest in railroading awakened in the boys. Some undoubtedly will return for jobs during coming vacations and may take permanent positions when they are through school. It is even possible that the Pere Marquette has been incubating a few railroad-company moguls.

NO TIME TO QUIT

AS THIS is written, there is a general feeling, backed by official pronouncements, that the war in Europe is nearing its final phase. The enemy isn't on his knees yet, but his legs are getting a little shaky and his nerves are badly frayed. Attacked from three sides now, almost incessantly bombed from the air, and with his sources of vital petroleum reduced to the Ploesti field, it is a foregone conclusion that Germany cannot long hold out unless she decides to sacrifice thousands of lives in a last ditch stand. As yet, however, there are no definite signs of capitulation, and a decision may not be reached for a considerable time.

One of the hardest jobs facing the governmental authorities here at home is to keep war production going at full speed until victory is actually won. Any slackening of the effort on this side of the Atlantic now might have direful results abroad. General Somervell of the Army Service Forces has stated that the forces in France are still short 320 critical items and that there are at least a dozen more in which shortage may develop at any time.

The problem of getting these items to the fighting men has changed somewhat within the past year. In the early stages of the war, raw materials constituted the bottleneck. Now, these are generally in good supply and there is an actual surplus of some of them. The shortage at present is in manpower. Not that we don't have sufficient workers, but rather that they are not properly distributed. Even though some forms of production are slowing up, there are others that have not yet reached their peak and can't reach it unless manpower stays on the job.

The civilian population is tired of war and its inevitable accompaniment of restrictions. The public psychology is one of victory, and some workers are inclined to feel that we are "over the hump." The truth is that we are winning, but the game isn't over. The other side still has one or more times at bat, and anything can happen.

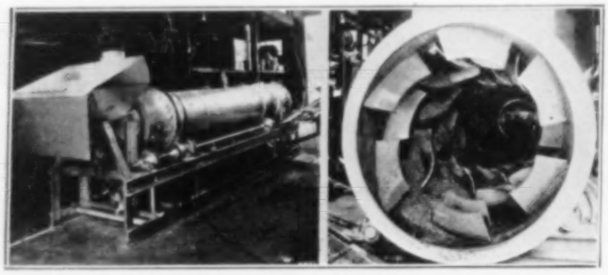
To meet the situation, Director of War Mobilization James F. Byrnes has taken effective steps to control the manpower problem by areas through an extension of the system that was put into effect on the West Coast last September. Area Production Urgency Committees will be charged with the responsibility of keeping men at work in plants that are still producing critical items and of transferring to them any surplus labor that may become available in their individual districts.

The necessary machinery has been set up, but it will not be effective unless the people in those areas coöperate. There must be a realization on the home front that it is just as important to work now as it was a year ago. As Director Byrnes says, "We must produce until the last shot is fired. People want to leave their jobs in war plants in order to get back to civilian business. If the present exodus from war plants continues, it is going to interfere seriously with the possibility of an early end of the war."

Rotary Drier for Metal Chips

As an adjunct to the reverberatory furnace, the Industrial Heating Equipment Company has developed a rotary drier for the processing of water- or oil-wet nonferrous-metal chips. The latter are fed in a steady stream from a hopper into a horizontal drum through which they are moved by a flight-and-bucket arrangement that lifts and drops them continually for fast, thorough drying. The combustion chamber at the discharge end is stationary and has a single gas or oil burner which provides enough heat for processing water-wet chips. If they are oil-wet, then the oil vapors serve as fuel and are ignited by the burner acting as a pilot. Steam, fumes, and unburned vaporized oil are expelled through a stack at the loading end.

The draft necessary for proper operation is induced and controlled by compressed air which enters the stack at a point directly above the hopper and is regulated in accordance with requirements. Air at a minimum pressure of 25 pounds per square inch is used, and the drying temperature is kept below 600°F. As the chips are discharged, they pass over a magnetic pulley which removes all ferrous metals. With material having a moisture content (oil, water, or a combination of both) of 15 percent, the drier has a capacity of 4000 pounds per hour.



EXTERIOR AND INTERIOR

At the left is a view of the drier from the loading end. A mechanical agitator in the hopper feeds the chips steadily into the rotating drum, which is 30 inches in diameter and may be 15 or 20 feet long. The shield at the lower edge of the hopper keeps chips and dirt out of the drive. At the right is an inside view of the drum showing the conveyor system that lifts and drops the chips to facilitate drying.

Ship to Shore by Water

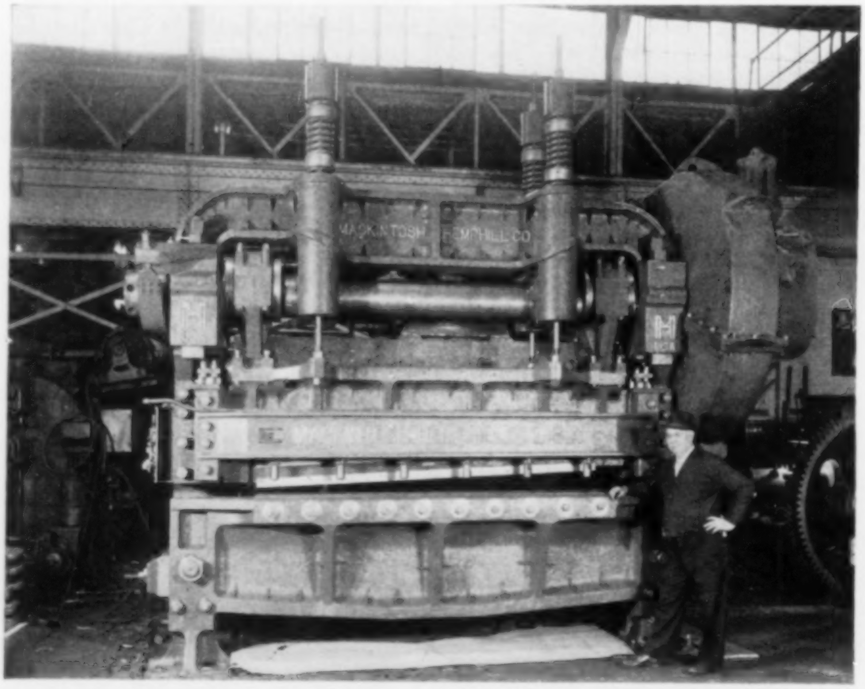
Waterproof bags are a vital factor in our Italian and southern Pacific campaigns because they make it possible to transfer delicate equipment and perishable supplies from ship to shore as soon as a vessel reaches port. The containers were developed for the U.S. Signal Corps by the United States Rubber Company and use natural air to give them the buoyancy needed to keep them afloat. The air is trapped in the top of the bags which, with their load, are guided through the water either by swimmers or by guy lines.

The bags are made of heavy duck coated both inside and outside with natural- and reclaimed-rubber compounds. They are not more than $^{3}/_{16}$ inch thick and vary in weight from 3 to 8 pounds, depending upon size and carrying capacity. They serve primarily to get medical supplies, instruments, and food ashore, as well as Signal Corps equipment, so that field hospitals can be set up and telephonic and radio communication established without delay. With that work done, they are used to protect materials in outdoor storage. These bags will withstand complete submergence in water for more than six days without letting in a drop of water or permitting dampness to penetrate.

Guard Those Tires

With the life expectancy of tires on heavy equipment only 30 percent of normal, a West Coast shipyard set about to discover the cause and to right the situation. It was found that nearly every tire of this kind in the service around the yard had deep gashes from contact with projecting steel and that side-wall cuts sometimes necessitated replacements even though the treads showed no signs of wear. With the facts known, a 3-point program of tire protection was proposed and has been put in practice there, as follows:

First, materials and supplies are stacked so as to assure roadways of sufficient width for the free movement of mobile equipment. Second, a truck-mounted electromagnet has been provided and cruises around picking up nails and other sharp bits of metal. This has resulted in a reduction in punctures of 70 percent. Third, and most important of all, each vehicle that runs on pneumatic tires is fitted with metal guards for their protection. Bolted to each wheel is a steel side-wall disk, and tires exposed to head-on contact have bumpers to take the blows. Since the adoption of these precautionary measures, the life expectancy of tires has been increased to 90 percent of normal and there has been a corresponding decrease in the monthly tire replacements.



FOR SAFER OPERATION

This huge shear is designed to cut 100-inch steel plate up to 1 inch thick and is the first Mackintosh-Hemphill machine of its kind to feature pneumatic clamps. In the earlier models the work was held down by springs or hydraulic clamps. The shear is provided with six of the new hold-downs, each of which is operated through the medium of an individual pneumatic cylinder. By the improved system the machine comes to rest after making one complete cycle whether or not pressure on the control button is released. The shear weighs 55 tons and has been built for a steel mill in India.

Industrial Notes

Synthetic rubber is salvaged by the same equipment that is used for reclaiming natural rubber and can enter into the manufacture of the same kind of article that was made of it originally.

In building the San Vincente Dam in California, the contractor had to leave an opening in the base of the structure for the busy Lakeside-Ramona Highway until it could be relocated. The hole was then plugged up by sealing the upstream end with a wooden patch and placing the concrete by the pressure method.

Skin creams for dry and wet working conditions are being made by The B. F. Goodrich Company. The one protects the skin against, dirt, grease, etc., and the other against dilute aqueous or mild chemical solutions. Both are said to reduce the hazard of dermatitis and to leave the skin smooth and soft.

Ajax Flexible Coupling Company has developed a screening device for salvaging and grading broken shot from blasting machines. The spent abrasive is fed into it at one end and delivered through separate spouts at the other. It is of dust-tight construction and operated by a motor-driven shaker.

Dektred, Griptred,and R-Mir Dek are among the new coatings that are serving in place of rubber to make floors, stairs, ships' decks, etc., slip-proof. The solutions contain a fine abrasive and are applied by a spray gun with air at from 50 to 60 pounds pressure. The liquid is carried in a 10-gallon tank, complete with control equipment and mounted on casters.

Brass-plated steel cables laid lengthwise, side by side, and encased in rubber form a new type of conveyor belt that has been made by the Goodyear Tire & Rubber Company in continuous lengths of as much as 13 miles. With a single layer of 5/32-inch cables, and rubber the equivalent of six plies of duck, the construction provides a belt that is as strong as 60 plies of duck.

Shortage of manpower is responsible for a compressed-air gadget that was built to meet a special job on Keswick Dam powerhouse, a U. S. Bureau of Reclamation project. It is a router for removing a 1-inch thickness of Fir-Tex, a joint-filling material, that was used so that the walls and columns of the structure could be poured separately. The device is made of 1/4-inch pipe 36 inches long and is reinforced by two pieces of 1/8x1-inch strap iron. Attached to the working end of the handle is a partial housing in which a 4-inch cutting wheel with eight teeth is rotated by compressed air fed through the handle. There is a 1/6 inch clearance between the cutter and the housing. The router is only 1 3/16 inch thick and is doing the work four times as fast as formerly when hand labor was required.

It has been indicated by extensive tests that a combination of Silicone resins, Fiberglas, and Micaglas provides an electrical insulation that remains flexible at a temperature of 482°F. for 50 hours. This would seem to promise considerably longer life for overheated windings. The material is made by the National Electric Coil Company and can be furnished in coil form only and in restricted quantities.

Bearings for aircraft engines are being examined for surface defects in a Cleveland plant under "black light"—light in the near-ultraviolet band of 3650 angstroms—because it is believed to be far more effective than the usual procedure and lends itself to mass production. By this method the work is cleaned, heated to open the pores, immersed in oil, and allowed to cool to trap the latter in any

TOMORROW'S SPECIFICATIONS
WILL INCLUDE
NAYLOR LIGHT-WEIGHT PIPE

POST-WAR REQUIREMENTS CALL FOR THESE NAYLOR ADVANTAGES

Always accurate in diameter.
Concentric ends match correctly.
Easier to install.
Holds true cylindrical form.
Stays tight and leakproof.
Stronger—safer.
High salvage value.
Light weight saves steel.
Cuts maintenance costs.
Saves money.
Sizes: 4" to 30" in diameter—all types of fittings, connections and fabrications.

No question about it! Naylor Pipe with its exclusive Lockseam Spiralweld structure has what it takes to do the job that will be required when peace comes.

The outstanding performance of this distinctive lightweight pipe on the battle fronts points the way to the solution of many mine-piping problems in the post-war period.

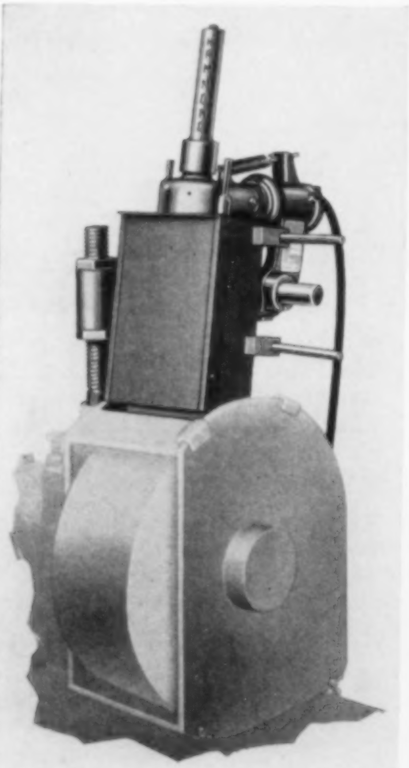
Write for Naylor Catalog

Naylor
LOCKSEAM
SPIRALWELD PIPE

NAYLOR PIPE COMPANY
1245 EAST 92nd STREET, CHICAGO 19, ILL.
New York Office:
350 Madison Ave., New York 17, N. Y.

cracks that might be present. Next, every trace of surface oil is removed, and then the bearings are again slightly heated to drive out any oil that may have seeped in by way of imperfections. When exposed to black light, surface defects are clearly revealed by the brilliant yellowish-green glow of the fluorescent oil.

Compressed air operates the new Hammond Machinery Builders automatic composition applicator—the Auto-Doper—and was chosen, according to the company, because it necessitates the use of but one moving part, reduces maintenance to a minimum, and because the cushioning effect of the air increases the unit's service life. It is suitable for use on any type of buffing or polishing machine and on horizontal or vertical wheel spindles. The composition is in the form of rectangular or cylindrical bars either of which may be applied simply by changing the housing of the doper. Air at a pressure of approximately 35 pounds is required, and control is effected by a 3-way valve actuated manually or automatically. One valve will suffice for several applicators provided all operate on the same stroke, up to twenty per minute. The composition is fed uniformly at the rate of 0.002 to 0.016 inch per stroke and the cylindrical bar is partially rotated at each stroke so that every part of its face is brought in contact with the buffing or polishing wheel regardless of the latter's width.



RECTANGULAR TYPE

This Auto-Doper is equipped to apply a buffing or polishing composition in the form of a bar 2 inches thick, 12 inches maximum width, and 10 inches long to wheels 2 to 12 inches wide. A cylindrical bar with a maximum diameter of 2¾ inches and 10 inches long can be substituted by changing the housing.

For workers in paint, chemical, woodworking, metallizing, finishing, and allied industries, the Wesley A. Gibbons Company is offering a new hood that is supplied with compressed air to protect eyes, respiratory organs, etc., from harmful mists, fumes, dusts, etc. Air at low pressure and from the same source that services the spray gun or other equipment used is fed into the hood through a distributing tube around the operator's waist. From there it is piped to the top of the hood, where a removable diffuser causes the air to expand and to float down over the head. There are two models—the Fumo and the Vapo. The first is designed for the metallizer, woodworker, etc. It has a transparent eye mask, and the air escapes by way of the neck. The second is for spray painting and allied work. It has no mask to become misted, and the descending air escapes by way of the eye opening and thus prevents fumes from entering. The headgear is pliable and all parts are replaceable.

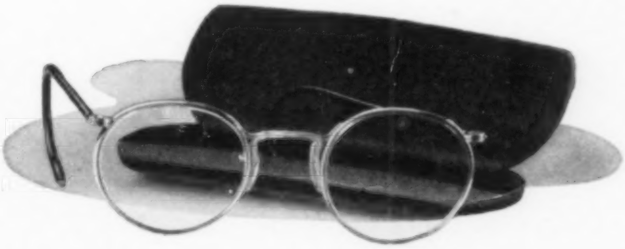
A track-mounted, self-propelled machine is offered by The Brown-Fayro Company for the removal of posts, headers, and rails in worked-out mine sections. The equipment is anchored by hydraulic jacks with removable extensions to meet height requirements and has a 2-speed transmission that can be changed quickly and without shock by friction clutches. It is said to exert a pull of 20,000 pounds when traveling at 10 feet per minute and to drag dislodged timbers, etc., at 100 feet per minute.

Coating wires between telephone poles and subscribers' buildings to increase their serviceability is now a regular maintenance job with some telephone companies and enables them to save considerable quantities of essential copper and rubber. The work is done by a robot painter—a simple device consisting of a rectangular paint container with two wheels, one of which travels on the wire to be coated and the other which does the coating. The latter, provided with a strip of felt, revolves in the paint and spreads it on the wire, while brushes at one end distribute it evenly and take up any surplus that might otherwise drip on pedestrians. The apparatus weighs about 6½ pounds and is attached to the handles used by linemen to trim trees, permitting it to be pushed along by a man on the ground at the rate of 50 feet per minute. It is reported that one containerful will cover between 300 and 400 feet of wire, depending on its condition.

Automatic high-speed tapping with precision Class III threads can be done on well-nigh any type of drill press, it is claimed, by equipping it with the Electroaire Power Feed unit recently announced by The Bellows Company. The unit makes use of a solenoid-controlled air motor or double-acting cylinder which advances and retracts the spindle. According to the manufacturer, feed and retraction speeds are independently regulated and subject to wide variation. Both are held under exact sensitive pressure at all times, thus preventing thread forcing and eliminating strain on the thread angle. Operation is effected by a foot switch, leaving the operator's hands free to insert and to remove the work. The Electroaire may be synchronized with solenoid-controlled jigs and fixtures to make the entire operation automatic, or it may be set for multicycle operation with indexing fixtures and dial feeds. By automatically slowing the rate of feed at the break through, tip burning and breakage of wire-size drills are greatly reduced, while precise depth control permits drilling or tapping blind holes to close tolerances. Stroke is adjustable up to a maximum of 1¼ inches.

BELLOWS
ELECTROAIRE
POWER UNIT

A $1.50 Investment that may save you $1000



This is a pair of AO Goggles. Their cost: around $1.50. On one of your skilled workers, they may save you $1,000 or more . . . for the eye accidents they help to prevent . . . *and the trained skill they help to protect.*

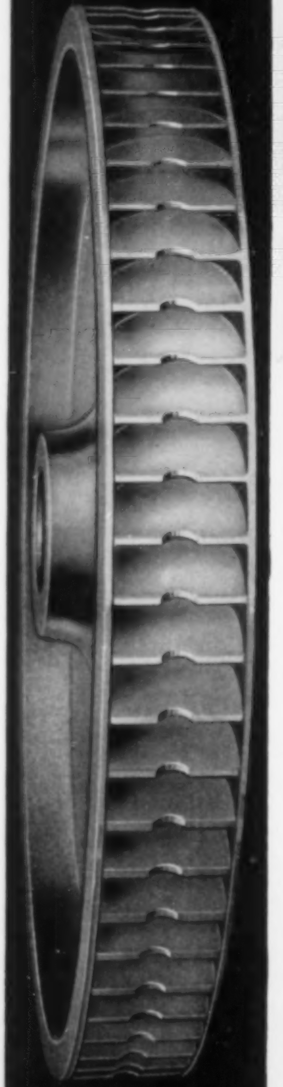
AO GOGGLES protect eyes & man-hours & profits

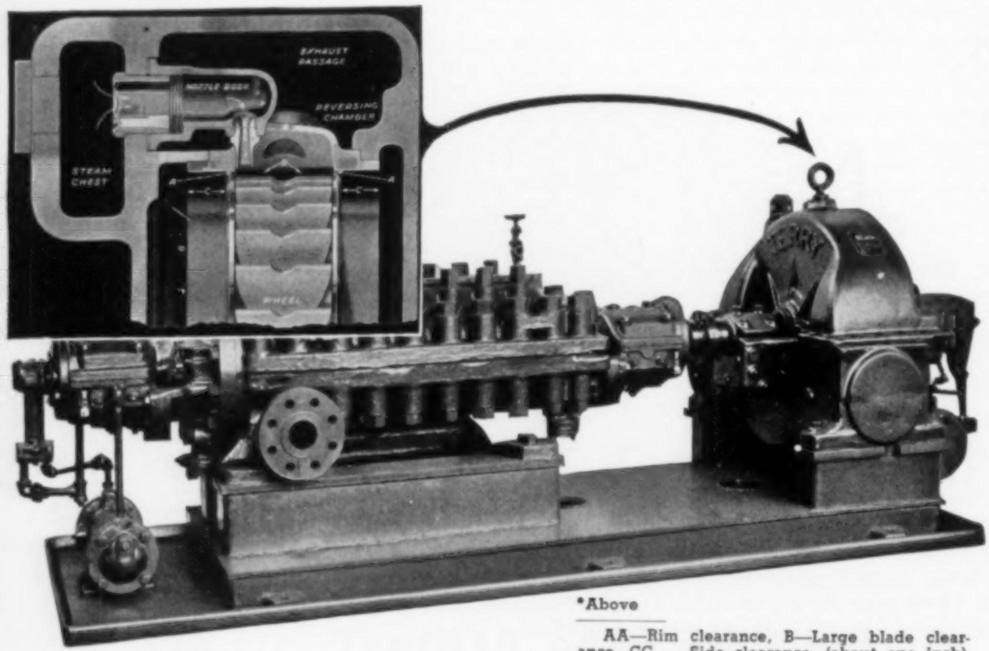
They're more than an investment in eye protection. For the price you spend for AO Goggles, you give a worker freedom from fear of injury. You let him concentrate on his job. You help him put in more man-hours. *And you keep production up and costs down.*

American Optical
COMPANY
SOUTHBRIDGE, MASSACHUSETTS

...CALL IN AN AO MAN—AND KEEP YOUR "PRODUCTION-EYES" PRODUCING

TERRY





*Above

AA—Rim clearance, B—Large blade clearance, CC — Side clearance, (about one inch). Blades cannot foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage **wheel.**

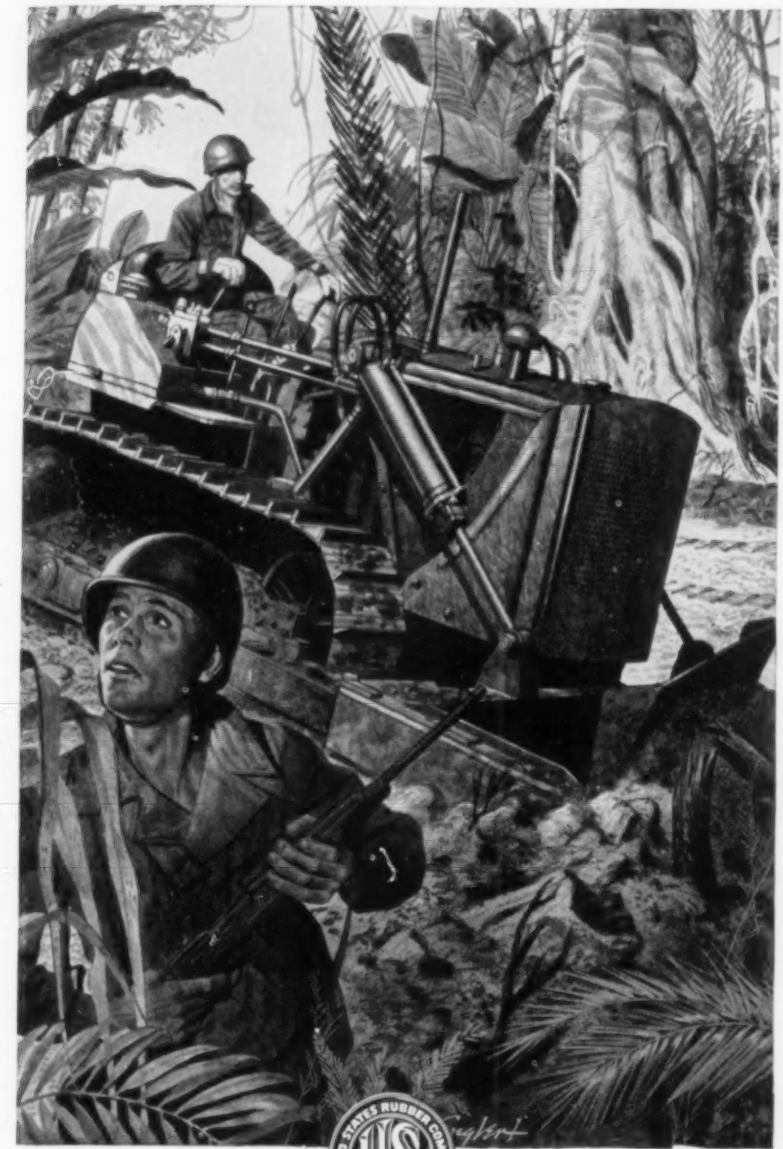
END PLAY WILL NOT DAMAGE THE BLADING OF THE TERRY WHEEL TURBINE

In the Terry Wheel Turbine the blades are protected by rims at the sides of the wheel, which would take without damage any rubbing that might occur if the clearance became reduced. With this construction it is impossible for the blades to foul and frequent inspection of the thrust bearing is not required to obtain safe and dependable operation.

The Terry Wheel Turbine is fully described in our Bulletin S-116. A request on your business letterhead will bring a copy.

T-1133

THE TERRY STEAM
TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



O.K.

SO YOU'RE IN THE DRIVER'S SEAT!

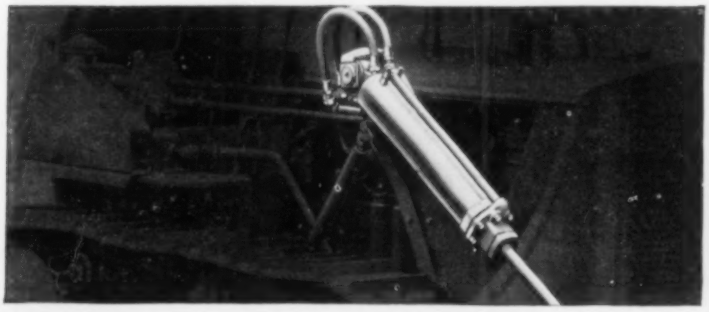
THE SNIPER'S bullets are still ping-ing... and you're being called on for everything from grading to pushing over pill boxes. That's when you find yourself whispering, *"Brother, this dozer's just GOT to go through!"*

And that means that the hydraulic system which operates these efficient machines must not falter—even when oil, circulating at low pressure, is stepped up to a punishing high.

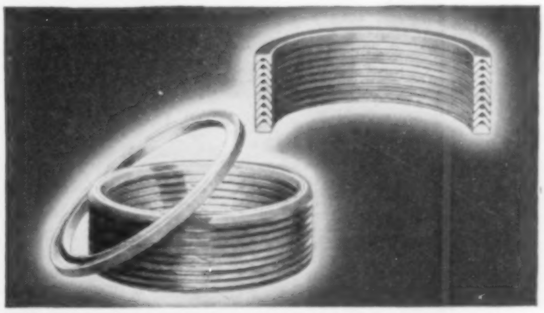
It means that hose and packing must take heavy punishment—be capable of withstanding extreme working pressures. United States Rubber engineers have developed types of hose and packing able to withstand this rugged treatment. The hose has wire-braided plies able to take heavy duty. Packing rings are automatic in action, responsive to pressure changes under temperatures ranging from -40° to 400° F.

Your equipment may never be put to such rigorous tests, but the greater margin of safety and dependability assures you longer, more trouble-free service.

SERVING THROUGH SCIENCE



HYDRAULIC CONTROL—Consists of pumps to create power, valves to direct it, a jack to apply it. U. S. Hose and Packing, both utilizing synthetic rubber, are impervious to destructive action of grease, oils, solvents and hydraulic fluids and capable of handling oil-pressures of enormous force.



U. S. MATCHLESS PACKING SETS—Are now being delivered in huge quantities to "dozer" manufacturers, Army Engineers, Seabees. Molded to accurate sizes; special top and bottom rings for square or bevel stuffing boxes.

Listen to the Philharmonic-Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E.W.T. Carl Van Doren and a guest star present an interlude of historical significance.

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE · ROCKEFELLER CENTER · NEW YORK 20, N. Y.

Specify Lebanon Ⓛ 21 for Weldments...

CORROSION-RESISTANT QUALITIES UNALTERED BY WELDING HEAT

MORE and more industries are taking advantage of the economies offered by weldments—composite units produced by the welding together of several castings. However, the size and shape of many of these structures prohibit post-welding heat treatment—a practice normally used to restore corrosion-resistant qualities lost through application of heat during welding.

The best solution of this problem is the use of a casting alloy that loses none of its corrosion resistance during the welding process. Lebanon has developed such an alloy in Ⓛ 21. Through the addition of columbium, this 18% chrome and 8% nickel steel is stabilized against the action of welding heat.

In austenitic 18 and 8 alloys, the remarkable affinity of columbium for carbon forms a stable columbium carbide constituent. This constituent protects against carbide precipitation and inhibits inter-granular corrosion. As a result, when heat is applied to Lebanon Ⓛ 21 during welding, the corrosion resistant qualities of this steel are retained intact. The need for post-welding heat treatment is eliminated.

Induction melting of Lebanon Ⓛ 21 permits close analytical control. It meets U. S. Navy Specification 46S27 for resistance to salt water as well as the corrosion requirements of a great variety of chemical, food, textile, petroleum and other processing equipment.

LEBANON STEEL FOUNDRY **LEBANON, PA.**

ORIGINAL AMERICAN LICENSEE GEORGE FISCHER (SWISS CHAMOTTE) METHOD

LEBANON Ⓛ 21

Chemical Analysis

Cr.	Ni.	C.	Cb.
18%-20%	8%-10%	.07 Max.	.68-.85

Average Physical Properties

Tensile Strength	80,000 lbs.
Yield Point	41,000 lbs.
Elongation	42%

LEBANON Ⓛ *Stainless and Special Alloy* **STEEL CASTINGS**

STRENGTH

FOR SAFETY AND LONG-TIME SERVICE

Specify

Vogt

DROP FORGED

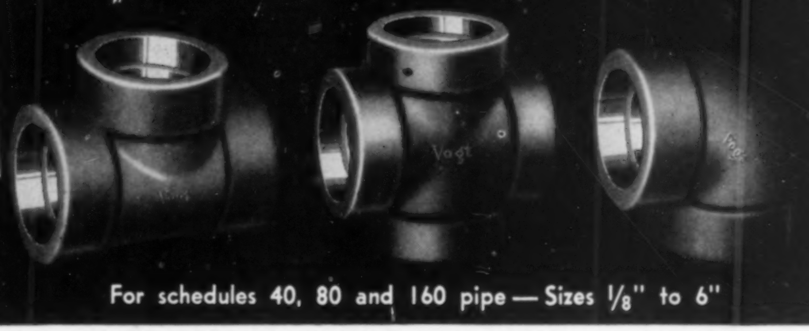
STEEL

FITTINGS

SCREW END TYPE

For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SOCKET WELD TYPE



For schedules 40, 80 and 160 pipe — Sizes 1/8" to 6"

Round-the-clock operation of oil refineries, chemical plants, steam plants, etc., essential to the continuous flow of war products to the United Nations, is all in the day's work for these fittings. Today, as in peacetime, Vogt drop forged steel fittings make a major contribution to the efficient functioning of pipe lines in plants vital to the war effort.

Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy.

Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-8 will aid you in their selection and proper application.

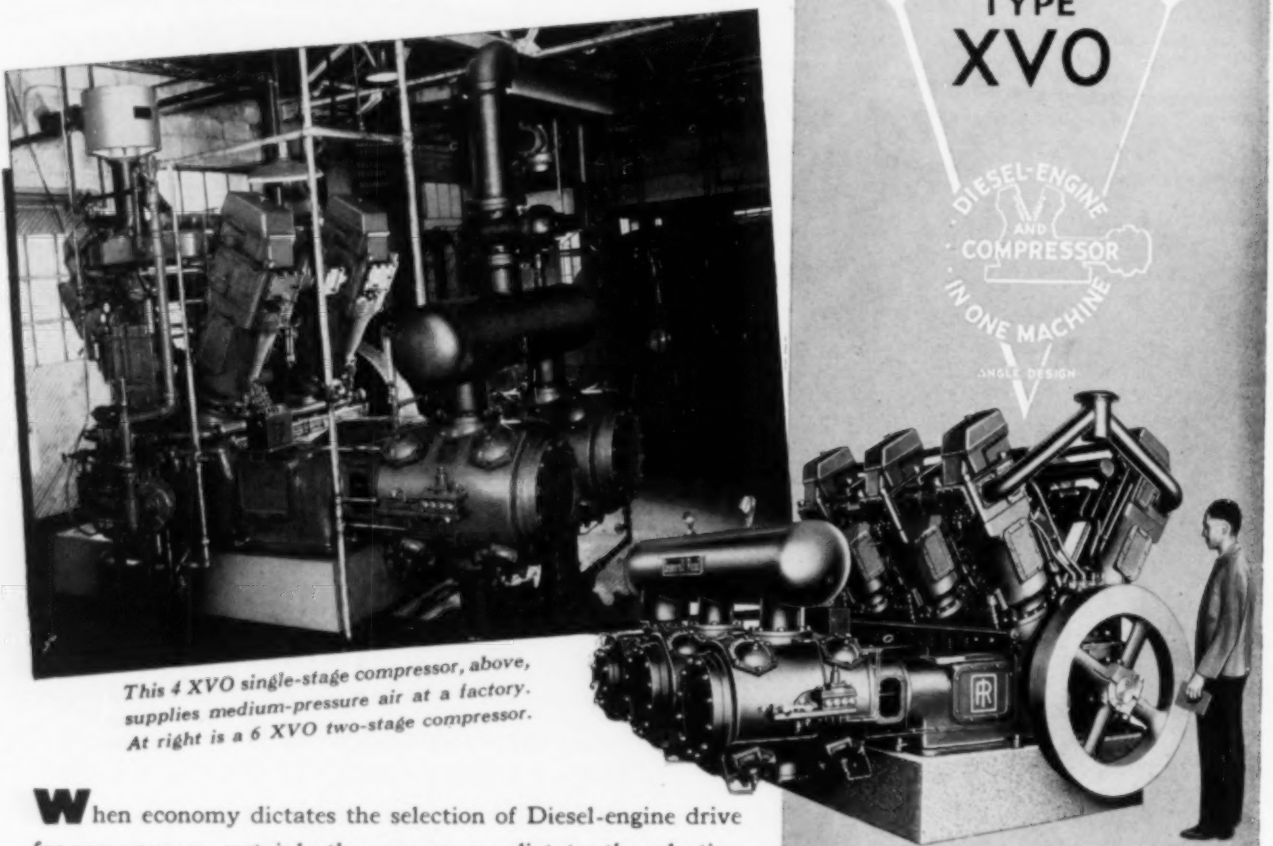
Vogt
FOR BETTER FITTINGS

HENRY VOGT MACHINE CO., Inc., LOUISVILLE 10, KY.

BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

Maybe YOU have compressor problems that can be solved with the DIESEL-DRIVEN

TYPE XVO



This 4 XVO single-stage compressor, above, supplies medium-pressure air at a factory. At right is a 6 XVO two-stage compressor.

When economy dictates the selection of Diesel-engine drive for compressors, certainly the same reason dictates the selection of the most economical type.

One gallon of diesel fuel will compress 5600 cubic feet of free air to 100 pounds pressure . . . in an *XVO*. Compare this high over-all economy with any other compressor plant.

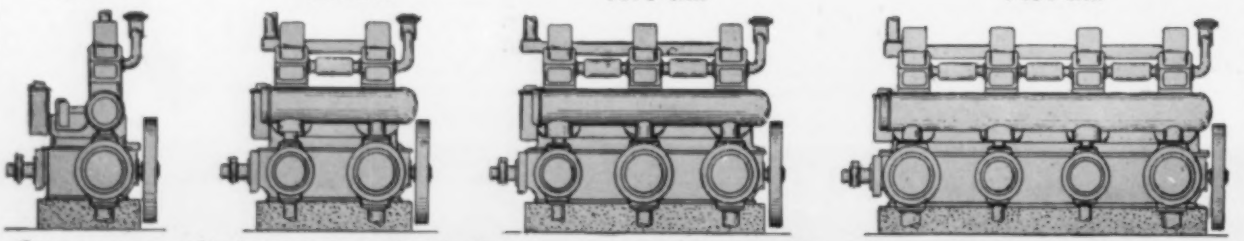
The XVO combines a heavy-duty, four-cycle diesel engine and a heavy-duty, double-acting compressor in a single, compact machine. It has fully demonstrated its ability to operate continuously at full load, 24 hours per day, over long periods of time . . . it was built for that purpose.

1. **IF YOUR COMPRESSOR PLANT SHOULD BE INDEPENDENT OR ISOLATED.**
2. **IF ECONOMY IS A PRIMARY CONSIDERATION.**
3. **IF EXISTING POWER FACILITIES CANNOT CARRY ADDITIONAL LOAD.**

***Select the* XVO**

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.
6-511

Cfm free-air actual delivery at 100-lb pressure and sea level



Compressor cylinders are available for air, gas, and ammonia . . . for practically any pressures

Reduce cylinder wear
MEMO from CHIEF ENGINEER
Order Cook's Graphitic Iron Piston Rings

AUTHORITIES differ as to the major cause of cylinder wear. But all are in agreement that the cost of cylinder wear together with the expense of cylinder and ring replacements in industrial size Diesels, constitute the major expense item on the maintenance sheet. Assuredly many variables enter the picture, but there is one thing certain—if piston rings could be dispensed with, little wear would occur. It is apparent then, that the piston rings to use are rings specially engineered to minimize wear. COOK has specialized in this all important phase of piston ring development for over 20 years, with the result that COOK'S GRAPHITIC IRON Piston Rings come as near to being frictionless as rings can be. If you do not have the full story of COOK'S GRAPHITIC IRON, write for special bulletin, but better still—to reduce the rate of cylinder wear in your engine, on your next requisition, instruct your buyer to order COOK'S GRAPHITIC IRON Piston Rings. If you need help do not hesitate to call on COOK'S engineers.

Sealing Pressures Since 1888

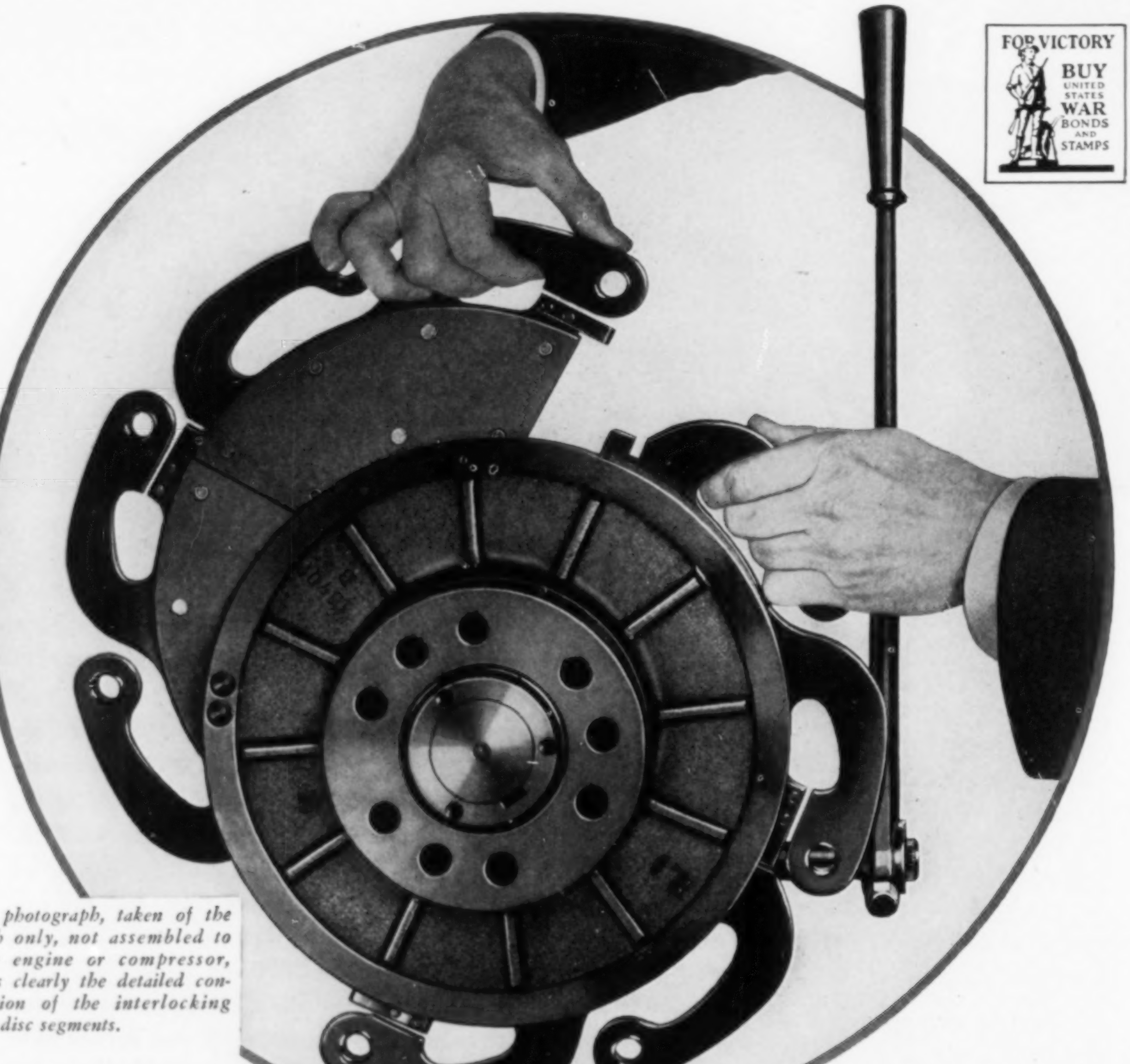
C. LEE COOK MANUFACTURING CO. INCORPORATED
LOUISVILLE, KY.

BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA

FLEX-DISC CLUTCHES

Used on the entire line of I-R *Mobil-Air* Compressors, have a time proven drive disc with flexible fingers solidly bolted to the fly wheel. When the friction facings become worn these drive discs, which are quickly detachable in segments, may be removed and relined or replaced without disconnecting the engine from the compressor.

FOR VICTORY
BUY
UNITED
STATES
WAR
BONDS
AND
STAMPS



This photograph, taken of the clutch only, not assembled to either engine or compressor, shows clearly the detailed construction of the interlocking drive disc segments.

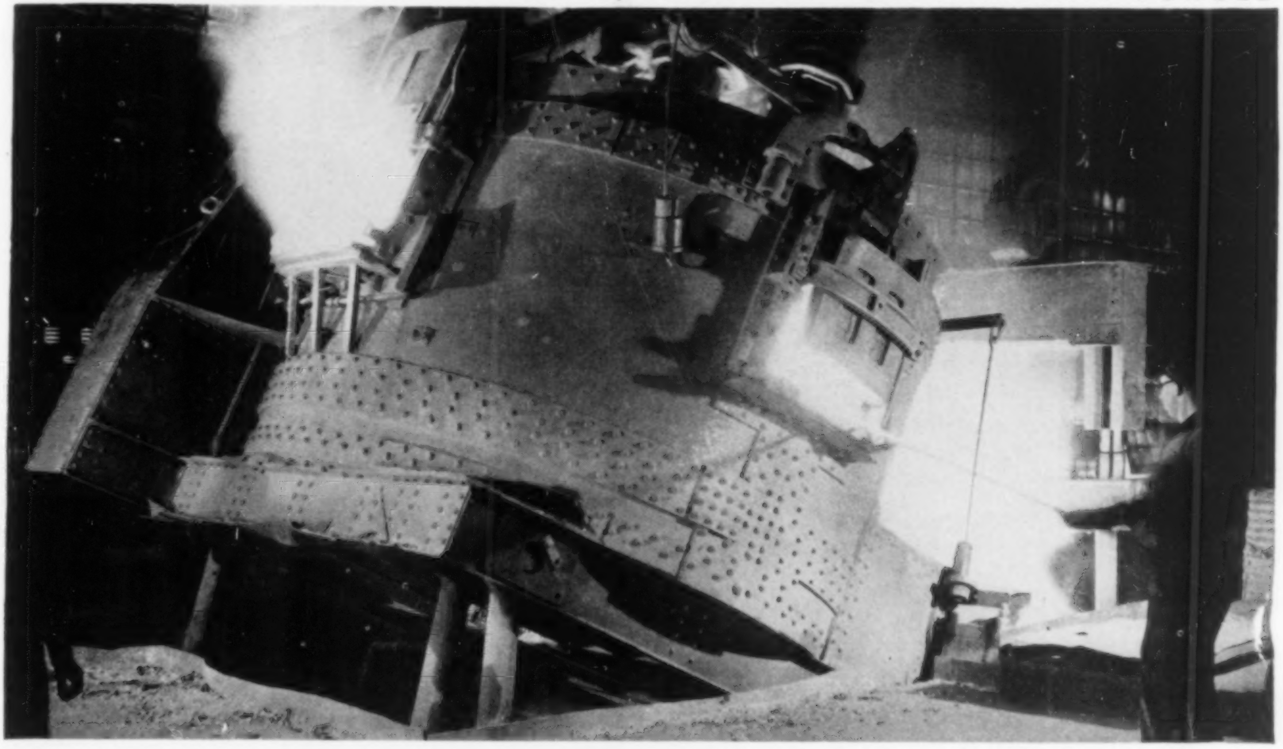
U. S. Patent Nos. 2,177,362;
2,259,461 and 2,303,201

NOTE: To save vital materials this advertisement will be used for "the duration."

C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin

IF THE FORGING IS HEAVY DUTY, IT SHOULD BE NATIONAL FORGED



The complete control characteristic of the basic electric furnace makes possible the National Forge reputation for producing "clean steel."

Preparing for Peace BY PRODUCING FOR WAR

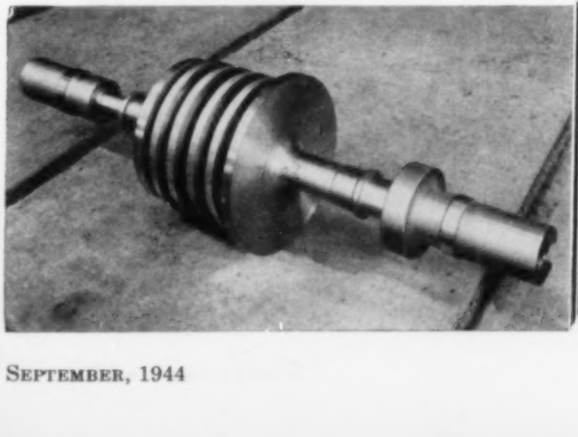
WHEREVER steel products are at war, none are more essential than the heavy duty steel forgings made for the Army and Navy by National Forge. The war effort here pre-dated Pearl Harbor by many months and brought the first "E" award to National Forge workers on October 24, 1941.

As the tempo of war quickened, National Forge responded with increased production—necessitating more plants, more equipment, more skilled workers. And that brought more official recognition—two additional "E" awards and three White Stars for sustained excellence in production.

The significant result of the "all-out" war effort at National Forge is that it has also better prepared this modern forge plant to make the steel forgings that will be equally essential in post-war production.

By making its own basic electric steel—by expanding and improving its heat treating equipment—and by trebling its facilities and personnel for high precision machining, National Forge looks forward confidently to meeting the exacting demands of peacetime industry. Then, as now, the forging that has heavy duty work to do will have a greater longevity of service if it is National Forged.

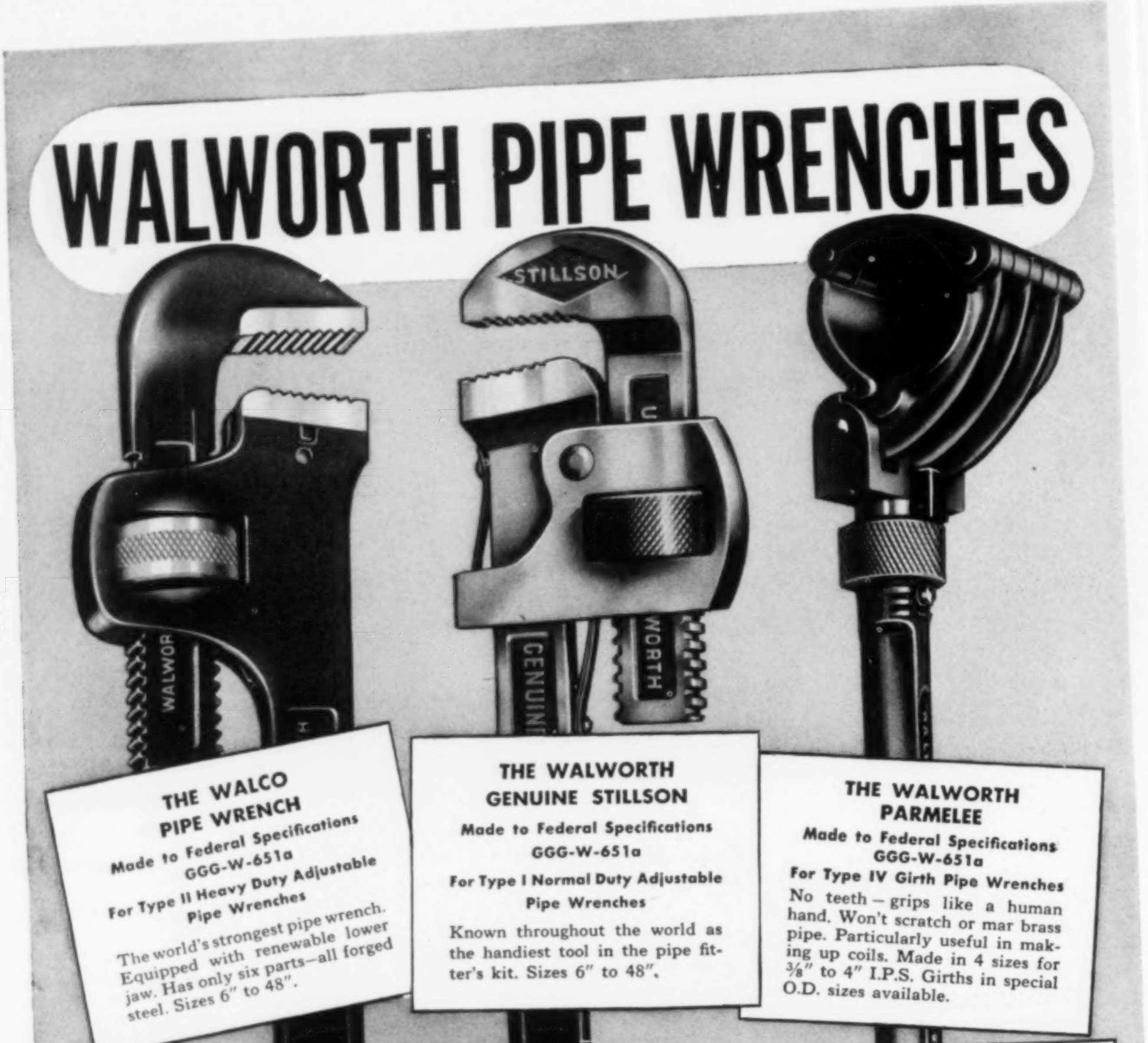
This steam turbine rotor is typical of the intricate special forgings produced at National Forge.



NATIONAL FORGE
& ORDNANCE CO.
IRVINE, WARREN COUNTY, PENNA.
"WE MAKE OUR OWN STEEL"

For Excellence E *in Production*

☆ ☆ ☆ ☆



WALWORTH PIPE WRENCHES

THE WALCO PIPE WRENCH

Made to Federal Specifications GGG-W-651a

For Type II Heavy Duty Adjustable Pipe Wrenches

The world's strongest pipe wrench. Equipped with renewable lower jaw. Has only six parts—all forged steel. Sizes 6″ to 48″.

THE WALWORTH GENUINE STILLSON

Made to Federal Specifications GGG-W-651a

For Type I Normal Duty Adjustable Pipe Wrenches

Known throughout the world as the handiest tool in the pipe fitter's kit. Sizes 6″ to 48″.

THE WALWORTH PARMELEE

Made to Federal Specifications GGG-W-651a

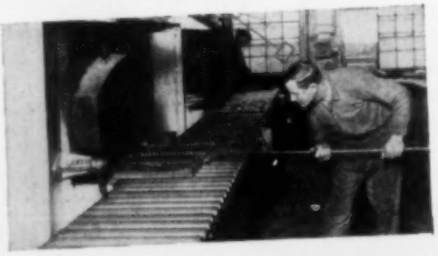
For Type IV Girth Pipe Wrenches

No teeth – grips like a human hand. Won't scratch or mar brass pipe. Particularly useful in making up coils. Made in 4 sizes for ⅜″ to 4″ I.P.S. Girths in special O.D. sizes available.

These three types of pipe wrenches are manufactured by the Walworth Company, and are noted for their safety, strength, and simplicity of operation.

Walworth, with more than a century of "know-how," also manufactures a complete line of valves, fittings, and pipe. For details see your Walworth distributor, or write on your company letterhead for free copy of Catalog 42.

METALLURGICALLY MODERNIZED



The most advanced metallurgical procedures are employed in the manufacture of Walworth Pipe Wrenches. Forging, heat-treating, and machining operations are performed with modern production equipment under strict supervision. In this way Walworth maintains the high standards of quality that have made Walworth pipe wrenches famous throughout the world.

WALWORTH

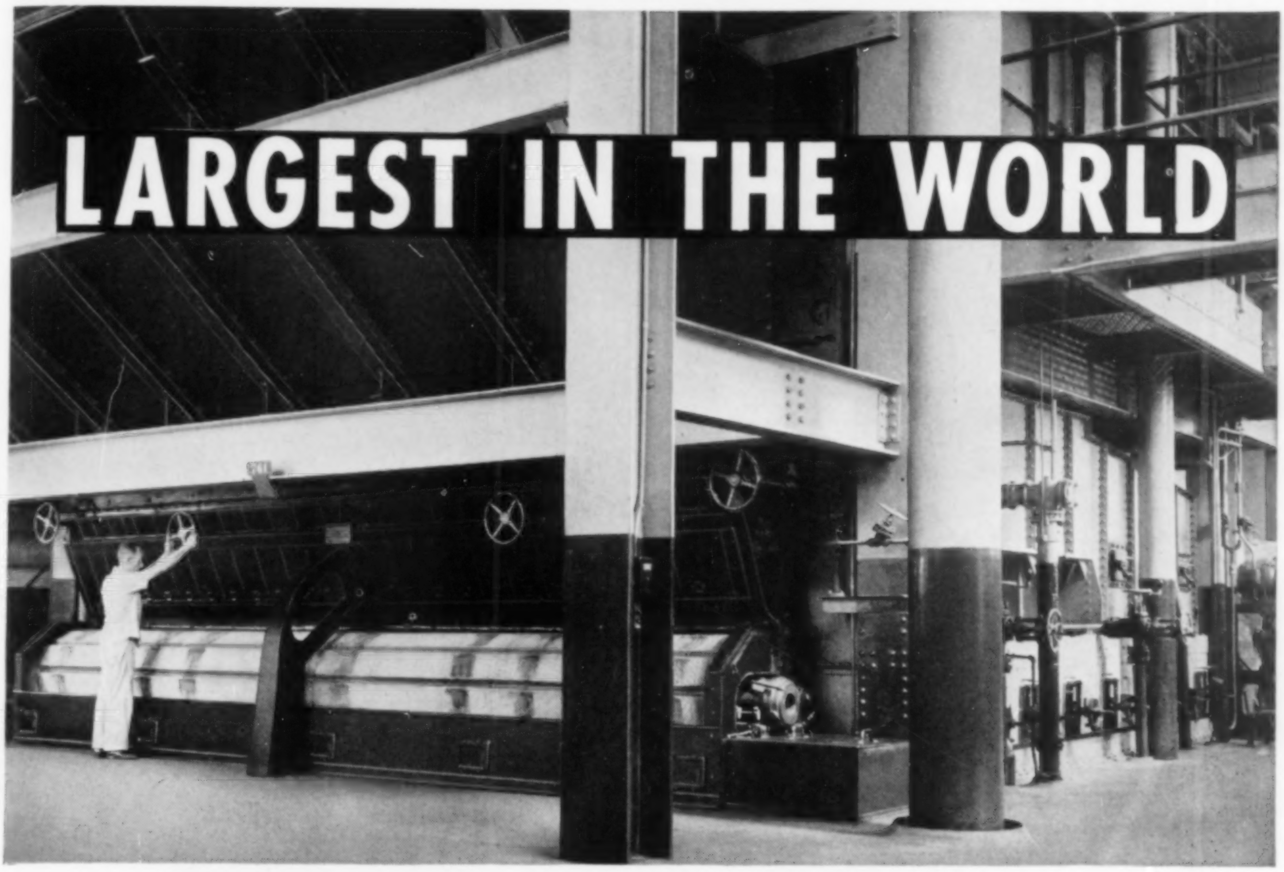
valves AND fittings

60 EAST 42nd ST., NEW YORK 17, N.Y.

BOSTON WORKS
KEWANEE WORKS

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

LARGEST IN THE WORLD



View at front of stoker. Coal is fed automatically onto traveling grate from large hopper above. Ash is discharged continuously at the rear.

Visualize the grate of the average house heating furnace and enlarge it in your mind to a surface 28 feet long by 24 feet wide – 672 sq ft. You will then have an accurate idea of the stoker that has more grate surface than any other stoker in the world. You could arrange all your living room furniture, including the piano, on its spacious grate and still have space to spare.

This mammoth machine, weighing 250,000 pounds, burns more coal in a single hour than a good sized home would need for an entire heating season. And it's a low priced type of anthracite that your home furnace couldn't burn – so small that all particles pass through an opening of 3/32nds of an inch. Installed in a large chemical plant, this C-E Stoker helps to produce vitally important war materials.

Combustion Engineering has designed and built many other large stokers, some almost as large as the one described here. On the other hand, there are C-E Stokers with grate surfaces as small as 7 sq ft – small enough for a large residence. Between these extremes, C-E Stokers cover every requirement with seven basic designs comprising the most extensive line of stoker equipment offered by any manufacturer. It takes experience to build such a line of stokers and C-E designs reflect over 50 years of continuous identification with the stoker business. During this half century, C-E Stokers have been applied to boilers with an aggregate capacity of more than 5,000,000 horsepower.

If you want top performance and economy in your next stoker installation the way to obtain them is by specifying C-E.

A-803

Combustion Engineering Company, Inc.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

SAVE.... WITH MAXIM HEAT-RECOVERY SILENCERS ....FUEL

The source of heat used by Maxim Heat Recovery Silencers is engine exhaust heat, normally wasted. From this heat and hence without the use of any additional fuel, steam or hot water for heating or processing operations is developed in practical usable volume. In addition, effective silencing of exhaust noise is accomplished (with or without the spark arrestor feature).

From an efficiency point of view the use of Maxim Heat Recovery Silencers is good practice at any time. From a national fuel conservation point of view their use is more than ever indicated today.

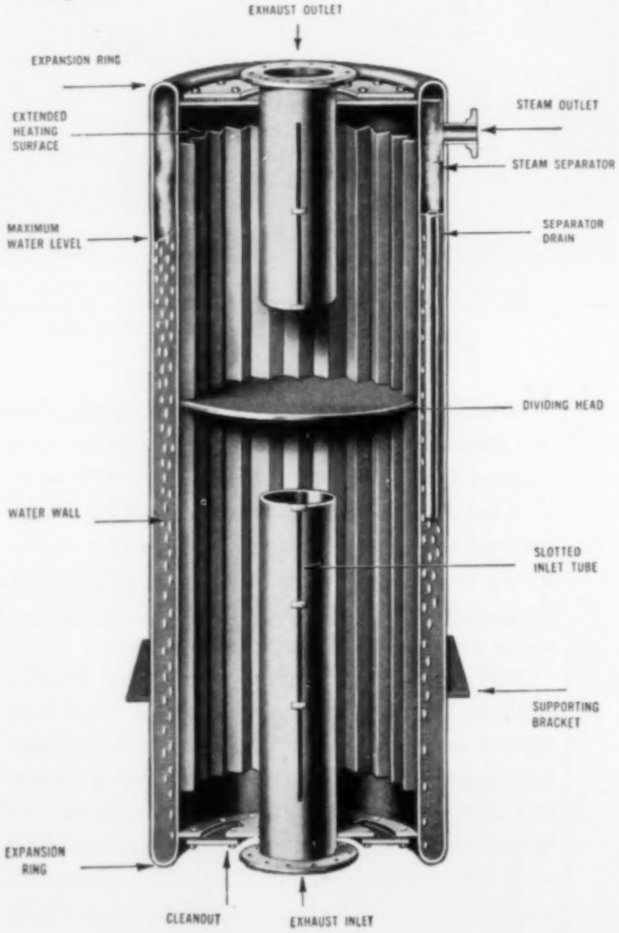
★ ★ ★ ★ ☆ ☆ ☆ ☆ ★

Maxim Silencers without the heat recovery feature are available for effective silencing of internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.

TYPICAL HOOK-UPS

The Maxim Engineering Department has prepared several drawings of typical Heat Recovery Silencer hook-ups. These are available with a detailed discussion of each hook-up. We will be glad to send them to you. Simply ask for Dwgs. B-298, B-301, B-302 and B-303.

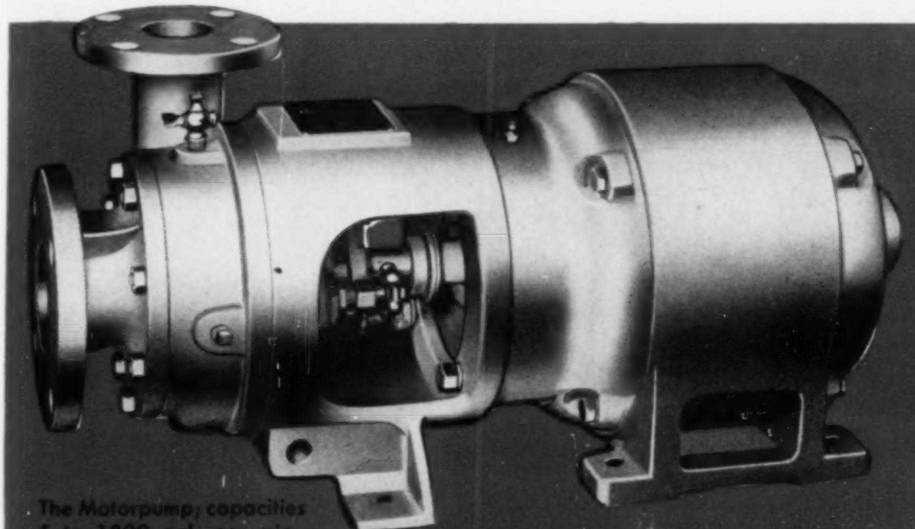
Why not present your specific problem to Maxim engineers? Descriptive Bulletins WH-100, WH-102 and WH-103 will be sent promptly on request.


EXHAUST OUTLET
EXPANSION RING
EXTENDED HEATING SURFACE
STEAM OUTLET
STEAM SEPARATOR
MAXIMUM WATER LEVEL
SEPARATOR DRAIN
DIVIDING HEAD
WATER WALL
SLOTTED INLET TUBE
SUPPORTING BRACKET
EXPANSION RING
CLEANOUT
EXHAUST INLET

THE MAXIM SILENCER CO.
85 Homestead Ave., Hartford, Conn.

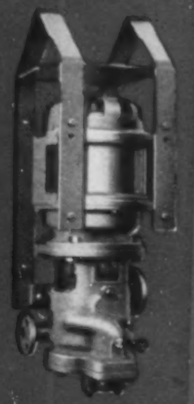
MAXIM

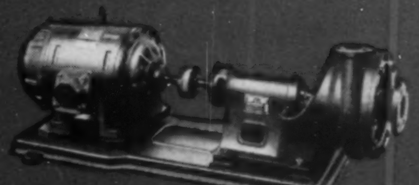
THE MOTOR PUMP IS MANY PUMPS



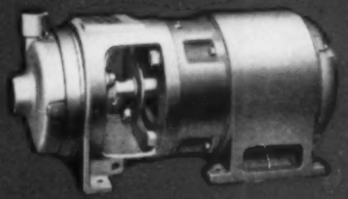
The Motorpump; capacities 5 to 1800 gal. per min.; heads to 500 ft.

Sling-yoke mounting for mine-shaft or contracting work.

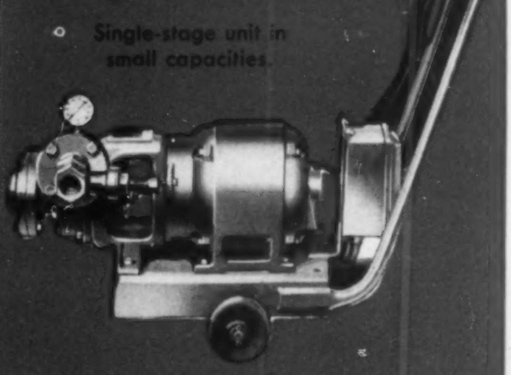




Cradle mounting, class CRV.



Single-stage unit in small capacities.



Portable mounting.

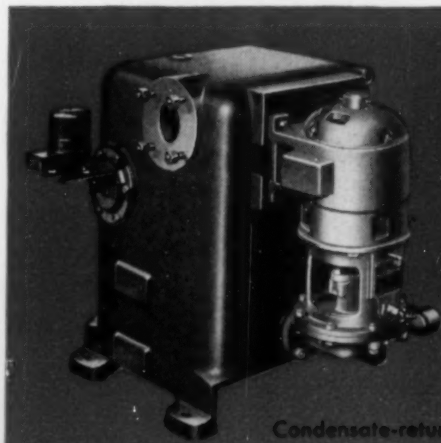
..one of them will fit your job

Motorpumps are highly efficient, compact and sturdy pumps. There are sizes small enough to be held in the hand and others to handle as much as 1800 gal per minute. The basic unit has a built-in electric motor. However, various modifications such as built-in steam turbine, cradle mounting for any type of drive, sling-yoke mounting for mine or contracting work and many other mountings and special parts provide pumps tailored to your specific needs. Ingersoll-Rand Company, Cameron Pump Division, 11 Broadway, New York 4, N. Y.

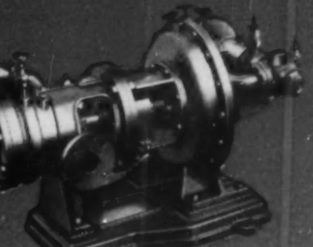
Ingersoll-Rand

9-401

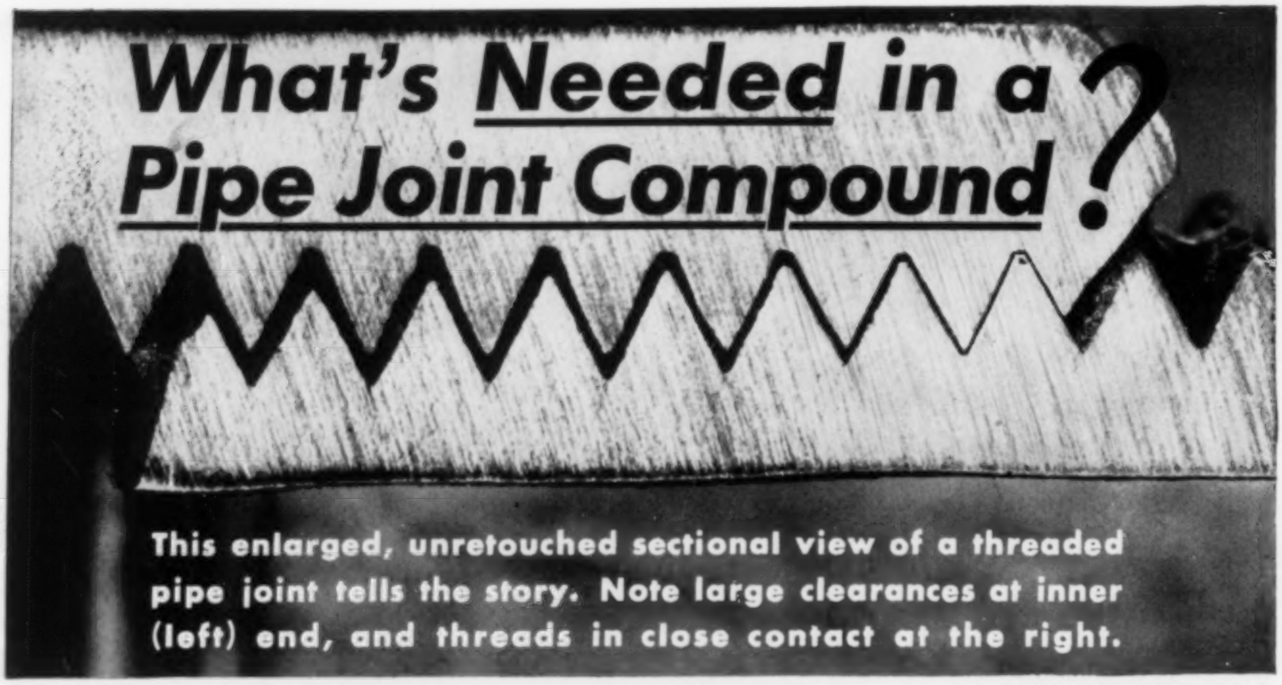
Ask the I-R Service Engineer for Further Details



Condensate-return unit.



Close-coupled turbine driven unit.



What's Needed in a Pipe Joint Compound?

This enlarged, unretouched sectional view of a threaded pipe joint tells the story. Note large clearances at inner (left) end, and threads in close contact at the right.

For leakproof, non-seizing joints, choose a sealing compound which

- —Readily fills all clearances and thread imperfections.
- —Seals *permanently*—insoluble in fluids handled (water, oil, steam, gasoline, butane, refrigerants, etc.)
- —Lubricates the threads to permit quick tightening.
- —Protects the threads; prevents galling, rust and seizure.

John Crane PLASTIC LEAD SEAL does all of this. In addition, it never hardens—so joints stay tight under vibration and strain, yet are easily disconnected after years of service. Ideal for both production assembly and general plant maintenance. Sold in 1, 5 and 7 lb. cans, ready for use. Send for free test sample; use it on joints, plugs, studs and gaskets.

JOHN CRANE
PLASTIC LEAD SEAL
FOR PIPE-JOINT SERVICES
-BLE · NON-CORROSIVE TO METAL
-7-0 NET WEIGHT

CRANE PACKING COMPANY

1810 CUYLER AVE. · CHICAGO 13, ILL.

BALTIMORE, BOSTON, BUFFALO, CLEVELAND, DALLAS, DETROIT, HOUSTON, LOS ANGELES, NEW ORLEANS, NEW YORK, PHILADELPHIA, PITTSBURGH, SAN FRANCISCO, ST. LOUIS, TULSA

CRANE PACKING CO., LTD., Hamilton, Ontario, Canada.
Branches: Montreal, Toronto, Vancouver

Powell's Past ... your assurance of Future Performance

For every problem in flow control, there'll always be a POWELL Valve to lick it!

Powell Valves for controlling flow in your industry were not just "born"—they're a product of evolution—the result of nearly a century of patient study, research and experimentation by Powell's staff of Engineers and Metallurgists. Therefore you can be sure TODAY that TOMORROW—as in the past—there'll be Powell Valves to meet every existing requirement for efficient, dependable flow control in compressed air services. The check valves shown here are especially adapted for use in air lines, the others for handling water for cooling compressors.

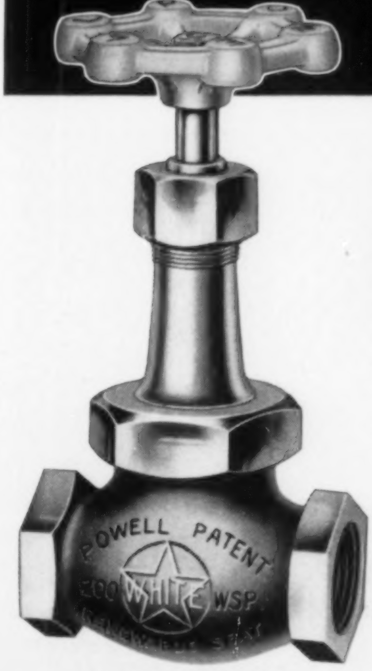
The Wm. Powell Company
Dependable Valves Since 1846
Cincinnati 22, Ohio

POWELL
UNION DISC

Fig. 150—A 150-pound Bronze Globe Valve with screwed ends, inside screw rising stem, union bonnet and vulcanized composition disc.

POWELL PATENT
WHITE
200 W.P.

Fig. 95—A Bronze Dash Pot Valve for 200 pounds air working pressure. Designed for air compressor service. Has screwed ends, screwed cap and regrindable, renewable nickle-bronze disc. Because of the cushioning effect of the plunger in the dash pot, the seating of the disc is practically noiseless.

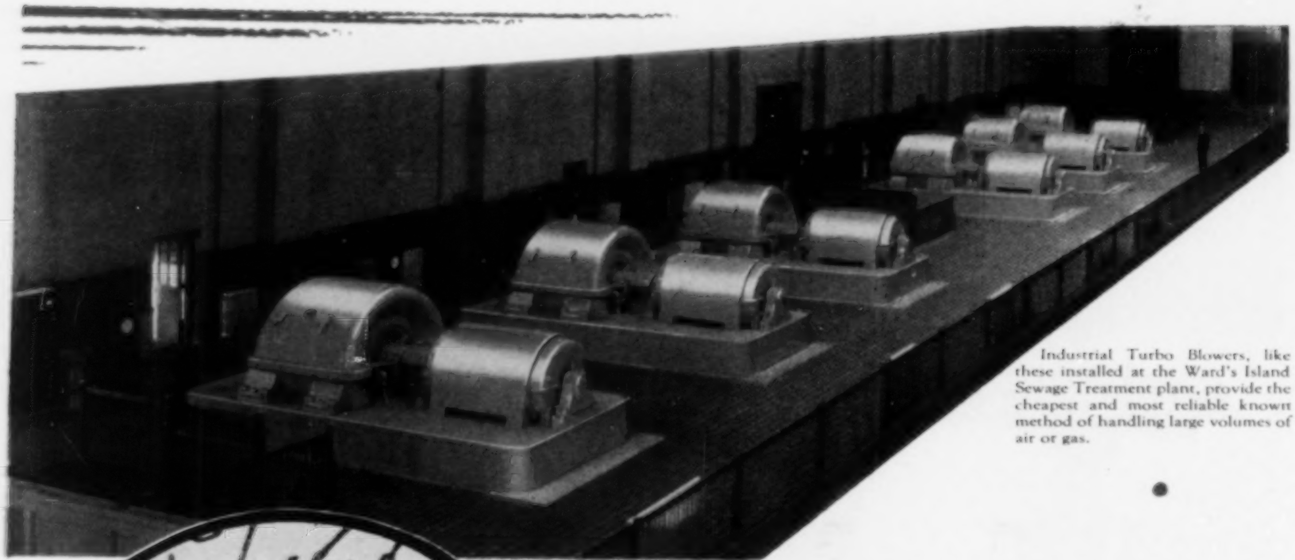


M.S.
POWELL
150
W.S.P.

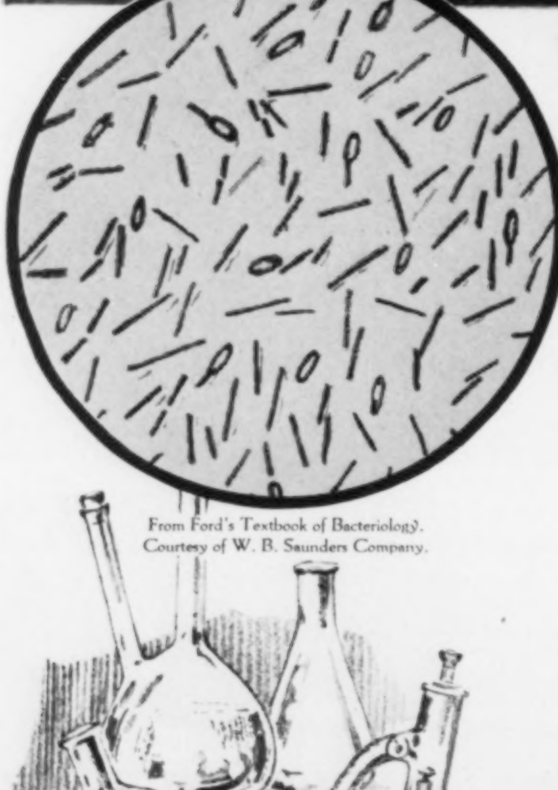
Fig. 312—A 150-pound Iron Body Bronze Mounted Horizontal Lift Check Valve, with flanged ends, bolted flanged cap, renewable bronze seat and vulcanized composition disc.

Fig. 102—A 200-pound Bronze Globe Valve with screwed ends, inside screw rising stem, union bonnet and regrindable, renewable nickel-bronze seat and disc.

POWELL VALVES



Industrial Turbo Blowers, like these installed at the Ward's Island Sewage Treatment plant, provide the cheapest and most reliable known method of handling large volumes of air or gas.



From Ford's Textbook of Bacteriology. Courtesy of W. B. Saunders Company.

12,000 horsepower
to keep these
BACTERIA HEALTHY

Bacteria do the hard work of purifying New York City's sewage. Aerobic bacteria they are called, for they "eat" best when they are surrounded by plenty of air or oxygen. This condition is most easily maintained by activated sludge aeration tanks such as those used by the Ward's Island Sewage Treatment plant. This installation purifies sewage much more completely than is otherwise possible.

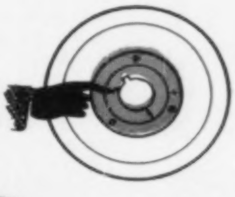
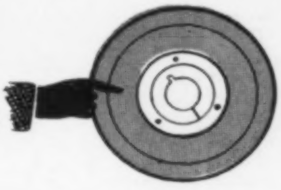
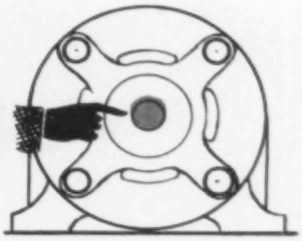
Here at Ward's Island there are six Ingersoll-Rand 2000-horsepower Turbo Blowers. If necessary, a total of nearly 250,000 cubic feet of air per minute can be blown through the aeration tanks.

Ingersoll-Rand's 30 years of experience in building blowers totalling several million horsepower is back of the highly efficient designs offered today in sizes of from 2 to 15,000 horsepower. Experienced engineers are available to help with your blower problems.

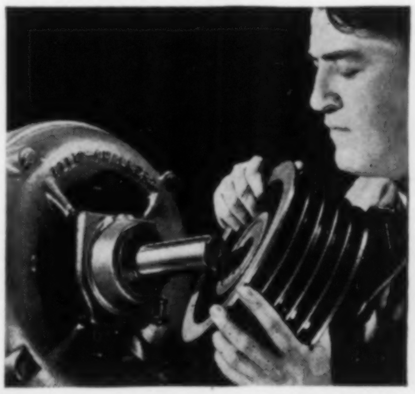
12-447

Ingersoll-Rand
11 Broadway, New York 4, N. Y.

TURBO BLOWERS   COMPRESSORS   AIR TOOLS   ROCK DRILLS   CONDENSERS   CENTRIFUGAL PUMPS   OIL AND GAS ENGINES

This  locks this  to this  in 1 quick operation

Allis-Chalmers' new "Magic-Grip" with tapered split bushing is put on, aligned, locked to shaft *as a unit* — making it the fastest mounting and demounting sheave on the market!



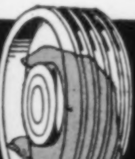
1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.

2 Slide to desired position. Sliding easily, sheave can be placed *exactly* according to straight-edge . . . giving you true alignment with resulting smooth performance. A minimum of time is required.

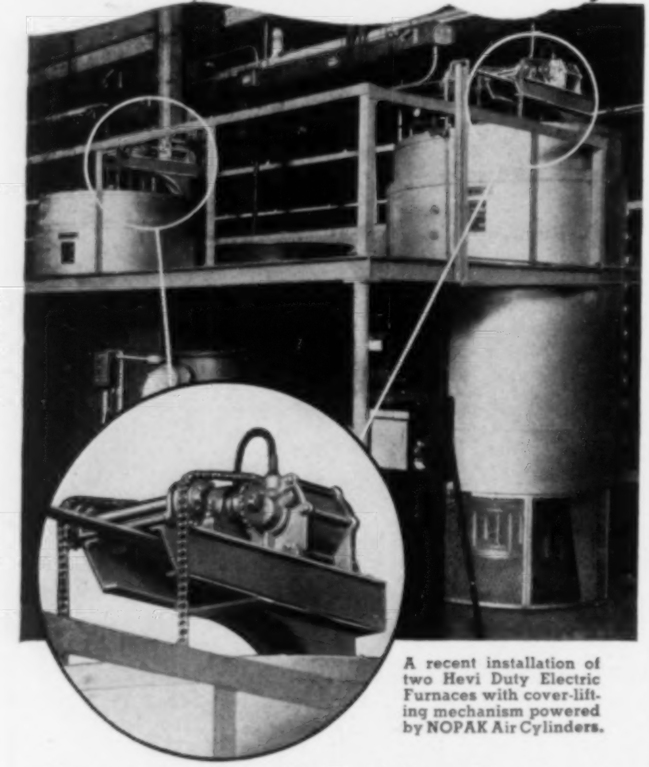
3 Tighten three capscrews — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic!* No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1757

Allis-Chalmers Texrope "MAGIC-GRIP" SHEAVES



1000 lb. Furnace Covers ...AN EASY LIFT with NOPAK Air Cylinders



A recent installation of two Hevi Duty Electric Furnaces with cover-lifting mechanism powered by NOPAK Air Cylinders.

Because Hevi Duty Electric Pit-Type Heat Treating Furnaces are charged from the top, the 1000 lb. steel cover is lifted and swung aside for every charge. To save time between charges, Hevi-Duty design engineers devised a simple, roller-chain lifting mechanism featuring ingenious 3-point cover suspension. Lifting power is supplied by a 6" Model A NOPAK Air Cylinder with 6" stroke, mounted directly on the swinging boom.

The positive-acting air cylinder, controlled by a NOPAK 4-Way Valve, lifts or lowers the heavy cover gently and accurately in a matter of seconds, conserving valuable heat-treating time.

This Hevi Duty solution to a heavy-duty lifting problem may suggest how NOPAK Cylinders may be used for lifting, pushing, pulling, positioning or clamping operations in your plant. Write for illustrated bulletins.

GALLAND-HENNING MFG. CO.
2759 S. 31st STREET MILWAUKEE 7, WISCONSIN

Representatives in Principal Cities

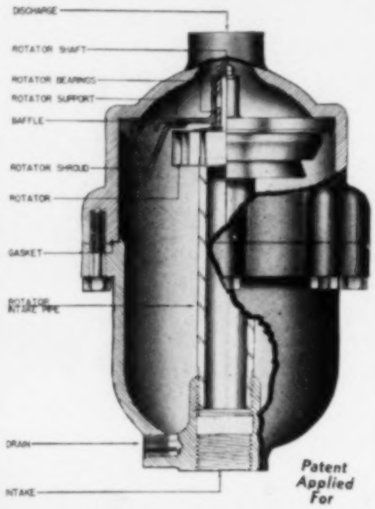
NOPAK VALVES and CYLINDERS
DESIGNED for AIR or HYDRAULIC SERVICE

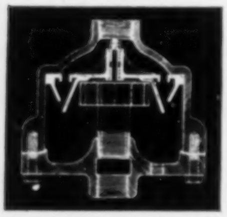
A 4462-½-R

NEW TURBO-ROTOR *Pur-O-fier*

For Compressed Air

This new unit effectively eliminates moisture, oil and scale from compressed air lines. Pur-O-fier utilizes the principle of centrifugal force to separate entrainments from purified air. Once installed it requires absolutely no maintenance. Penstar Tru-Bond oilless bearing guarantees long, trouble-free operation. Manual or automatic drains provided.

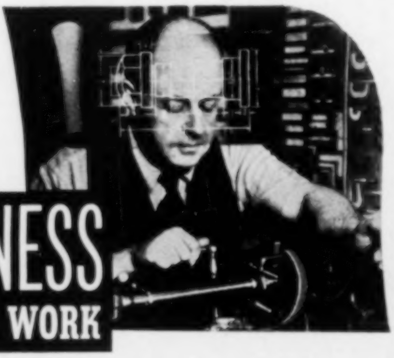




Drawing shows turbo-rotor, shroud and baffles. The design of the baffles precludes the possibility of capillary action of entrainments resulting from high velocity.

THREE MODELS AVAILABLE—A-1 will accommodate volumes from ½ to 5 cu. ft. A-2, volumes from 10 to 35 cu. ft. A-4, volumes from 35 to 100 cu. ft. Multiple units are recommended for volumes above this range. Pur-O-fier is the only standard unit that can be engineered to meet any air volume for regular or intermittent service.

BIRD-WHITE COMPANY
3120 West Lake Street, Chicago, Illinois



EXACTNESS RULES HIS WORK

How exacting he must be is dictated to him by a sheet of blue paper—a blueprint. There can't be any guess work here. Every detail—every dimension—every view must be shown in complete clarity. For on his ability to interpret the blueprint rests victory or defeat.

To take the "guesswork" out of blueprints, draftsmen . . . engineers . . . technicians . . . insist on working with

KOH-I-NOOR

because **KOH-I-NOOR Drawing PENCILS** can be depended on for sharp . . . crisp lines which produce sharp, clean prints. . .

because **KOH-I-NOOR Drawing PENCILS** can be depended on for the same fine quality that has made them standard for more than 50 years.

Available in 17 uniform degrees of hardness and softness. **ECONOMICAL IN THE LONG RUN!**

NO. 1700 — TECHNICRAYON PENCILS — 40 brilliant colors. Each is polished in the color of the lead . . . for easy identity. Available in sets only of 12 or 24.

KOH-I-NOOR

The RIGHT pencil for the RIGHT job
KOH-I-NOOR PENCIL COMPANY, INC., BLOOMSBURY, NEW JERSEY

COSTLY REPAIRS STOPPED BY DAYTON V-BELT DISTRIBUTORS

A Typical Example!

With the drive formerly used on this 75-ton automatic header, the bearings of the header and motor were punished so severely that the machine had to be frequently torn down and repaired.

A telephone call brought a Dayton V-Belt Distributor who made a study of the drive and recommended conversion to Dayton V-Belts. Seven belts were used with 11" drive pulley and 52" driven pulley . . . 45" center to center.

The Dayton V-Belt drive is now operating 20 hours a day and there are no worn bearings—no costly shutdowns and repairs.

Call Your Distributor for This Expert Service by Factory-Trained Men

No matter what your drive problems may be, it will pay you to phone your local Dayton V-Belt Distributor. Without obligation he will send a factory-trained Dayton V-Belt expert to study your drive. Ninety-nine chances in a hundred, the drive can be quickly converted to smooth-running, hard-gripping, long-lasting Dayton V-Belts—anything from fractional to a thousand horsepower. Then your troubles will be over.

Always remember that Dayton Rubber has more than 30 years' experience in building V-Belts of natural and synthetic rubber, and today, is the world's largest V-Belt manufacturer. Depend on Dayton V-Belts for the best and most economical performance—and depend on your Dayton V-Belt Distributor for the utmost in prompt, expert service

CALL YOUR DAYTON V-BELT DISTRIBUTOR OR WRITE DIRECT

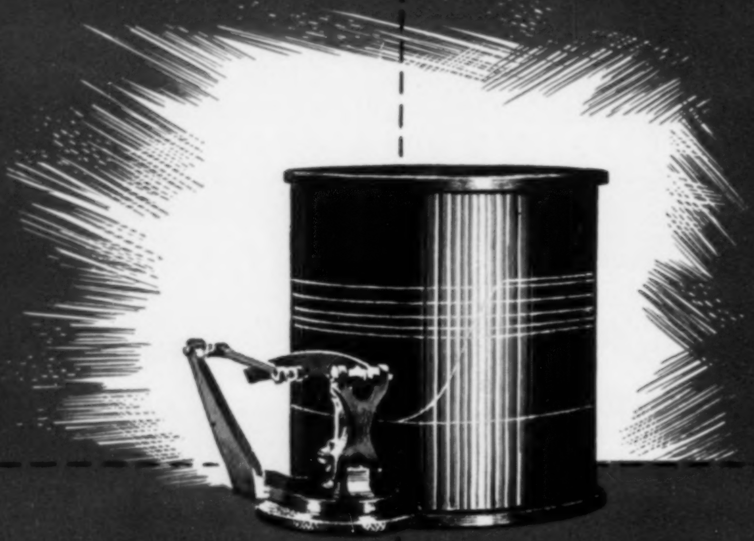
THE DAYTON RUBBER MFG. CO.
The World's Largest Manufacturer of V-Belts
DAYTON 1, OHIO
Dayton Rubber Export Corporation
38 Pearl St., New York, N. Y., U. S. A.
Cable Address: WIDBLOCO

MAINTAIN VICTORY SPEEDS—CONSERVE YOUR TIRES

V-Belts by Dayton Rubber

REG. TRADE MARK THE DAYTON RUBBER MFG. CO.

The Mark of Technical Excellence in Synthetic Rubber



DYNAMITE IN SLOW MOTION

TRANSLATING THE DETONATION of an explosive into a continuous line . . . and thus charting the exact rate at which pressure is developed is one of the tasks of the recording device pictured above. In effect, it produces a slow-motion picture of an explosion so that its characteristics may be accurately observed.

Through apparatus such as this in one of the most modern laboratories, Hercules technicians study the behavior of explosives of almost every type . . . and thus add to their background of knowledge. It is this wealth of experience—in research, in the field, and in manufacturing—that maintains a constant vigilance over the quality of Hercules explosives, for your benefit and ours.

HERCULES EXPLOSIVES

HERCULES POWDER COMPANY
INCORPORATED
932 King Street
Wilmington 99 . . . Delaware

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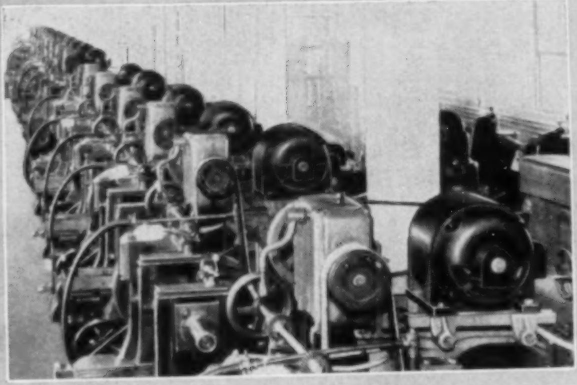
BEARINGS BEAR UP

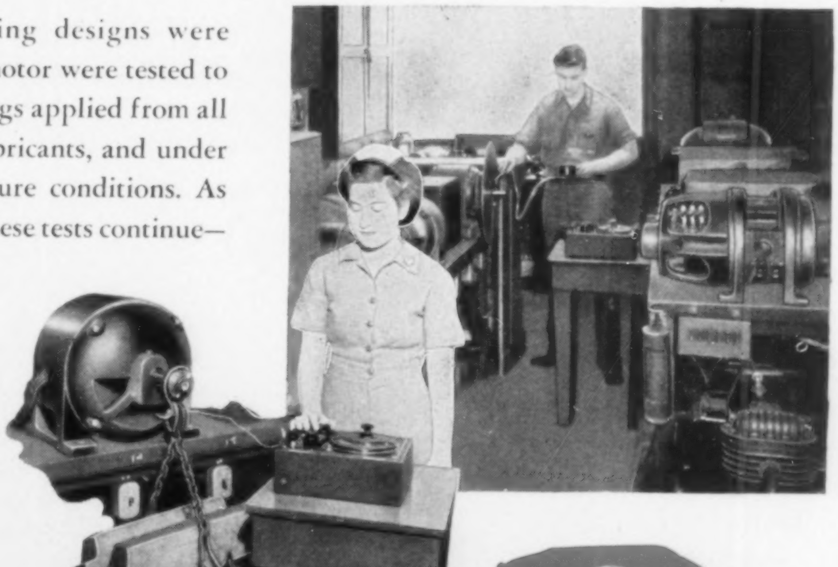


Powered by Tri-Clad sleeve-bearing motors, this battery of milling machines has been in round-the-clock operation on war work since before Pearl Harbor. The short-center, hinge-base drives put a hard, steady pull on the motor bearings. In addition, the machines are in the hands of several different operators each day, many newly trained. Despite the severe service, motor-bearing performance has been above prewar levels. Maintenance manpower has been conserved, and production held on schedule.

Tri-Clad motors driving milling machines in the River Plant Division of the Savage Arms Corp., Chicopee Falls, Massachusetts.

How torture tests on TRI CLAD bearings have helped us lengthen motor life

Before the Tri-Clad motor-bearing designs were adopted, many models of this new motor were tested to destruction under heavy shaft loadings applied from all directions, with various kinds of lubricants, and under many different speed and temperature conditions. As new Tri-Clad types are introduced, these tests continue—some for years—in "torture" areas such as shown at right. Each test broadens our knowledge, offers new clues to longer motor life. Throughout industry, results have substantiated the improved bearing performance forecast by these tests. *General Electric Company, Schenectady 5, New York.*



GENERAL ELECTRIC

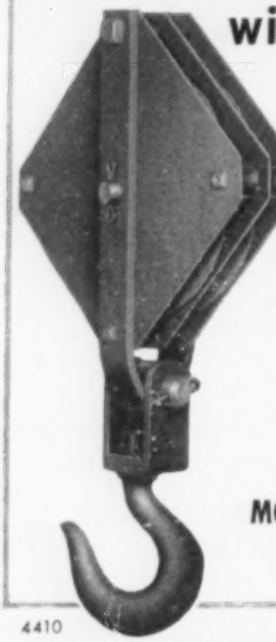
750-243-8030

TRI CLAD MOTORS

Buy all the BONDS you can — **AND KEEP ALL YOU BUY**

AMERICAN

wire rope blocks



Standard Duty

For average work which includes most of the service in industry and construction.

Heavy Duty

For extremely heavy construction and erection work.

MODERN DESIGN
RUGGED CONSTRUCTION

4410

AMERICAN HOIST & DERRICK CO.
SAINT PAUL 1, MINNESOTA
CHICAGO SAN FRANCISCO NEW YORK

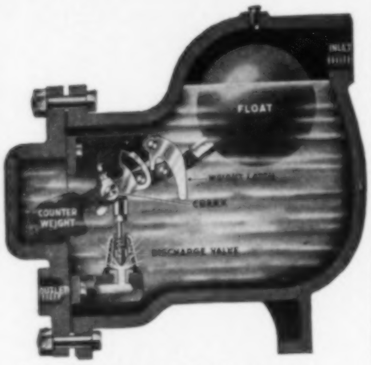
THE GENUINE
Crosby Clip
WHEREVER WIRE ROPE IS FASTENED

4 BIG REASONS

WHY

THIS TRAP IS AMERICA'S No. 1 TROUBLE SHOOTER for AIR SYSTEMS

Intermittent Discharge
★
Large Capacity
★
Welded Stainless Steel Float
★
Water Sealed Discharge Valve

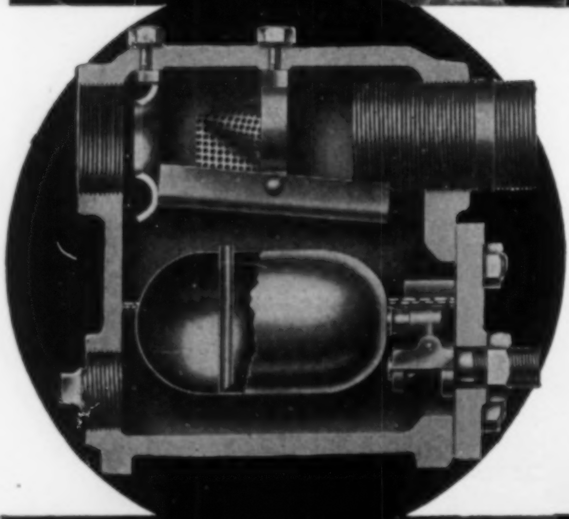


THE NICHOLSON MODEL "JR" COMPRESSED AIR TRAP is being adopted as "standard" in more and more plants, for automatically draining water and oil from compressed air separators, aftercoolers, receivers, etc. For air, gas, and saturated steam pressures up to 200 lbs. Made in one pattern size only, with either ½", ¾" or 1" inlet, and ½" outlet. Bulletin No. 341.

W. H. NICHOLSON & CO.
180 OREGON ST., WILKES-BARRE, PA.
Valves ★ Traps ★ Steam Specialties

DRI AIR MAY BE INSTALLED BY SUSPENDING IT FROM THE PIPING WITHOUT ANY OTHER SUPPORT.

INCREASED PNEUMATIC EFFICIENCY WITH THIS AUTOMATIC SEPARATOR



PROTECT EQUIPMENT WITH

DRIAIR

SEPARATES • COLLECTS • DELIVERS

• DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

A TYPICAL INSTALLATION SHOWING DRI AIR STANDING ON A CONCRETE FLOOR NEXT TO THE WALL.

WRITE FOR BULLETIN DA WHICH FULLY DESCRIBES THE CONSTRUCTION AND OPERATION OF THE DRIAIR.

NEW JERSEY METER CO.
"SPECIALISTS IN COMPRESSED AIR DEVICES"
PLAINFIELD, NEW JERSEY

"Aero-Seal"

HOSE CLAMPS

Distinctive worm gear tightening action provides powerful belt-like pull-up. Uniform pressure all around prevents leaks. Can be put on or taken off hose in place on pipe. Can be re-used. No loose parts. Compact design. Extremely long take-up. Made in sizes from ½" up. *Write for circular.*

Proved outstandingly reliable in severe service on aircraft fuel, oil, and coolant lines.

AIRCRAFT Standard PARTS CO.

Aircraft Standard Parts Co.

1771J NINETEENTH AVE., ROCKFORD, ILL.

There Is No Compressed Air Condition So Bad In Any Factory That We Cannot Correct and Completely Remedy

WATER removed from AIRLINES AUTOMATICALLY with the MURPHY SEPARATOR

AIR OUTLET
AIR INLET
WATER EXHAUST

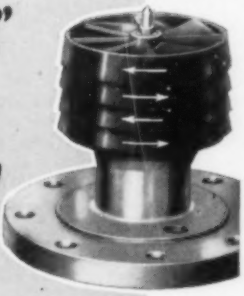
SIZES ½" TO 4" PIPE

Literature and Prices on request

RESULTS - - - GUARANTEED
NO ABSORBENTS - NO CHEMICALS
AFTERCOOLERS - - - SPRAYERS

JAS. A. MURPHY & CO.
HAMILTON, OHIO

These "Spinning Rotors" Really Clean Compressed Air!



DRY CLEAN AIR
WET DIRTY AIR
DRAIN

There is one method that thoroughly removes moisture, oil, dirt and scale from compressed air—*centrifugal force* as applied in the Aridifier.

Why experiment with air separators that clog, require periodical cleaning or replacement of elements, cause back pressure or effect only partial removal of contamination? Follow the lead of plants with outstanding war production records and install Aridifiers. You will assure yourself of clean, dry compressed air continuously. Write for bulletin.

LOGAN ENGINEERING CO.
4911 Lawrence Ave., Chicago 30, Ill.

Logan ARIDIFIER
Dries and Cleans Compressed Air

REMOVES
OIL
WATER
DIRT

No Time Lost...

Bearings Poured with Babbitrite!

- Babbitrite—the *safe* babbitt retainer—never blows out—contains no moisture to generate steam.
- Babbitrite—has greater strength, greater capacity to hold a charge of hot, molten metal.
- Babbitrite "sticks tight" to mold or journal under all working conditions.
- Babbitrite does not melt and allow molten babbitt to run out.
- Babbitrite does not dry or harden, yet stays moisture-free.
- Babbitrite requires no mixing, is always ready for use, may be re-used over 100 times.

Babbitrite has other uses in Casting, Heat-Treating, Finishing. Write for Literature and Liberal Sample.

Babbitrite
THE BABBITT RETAINER

PRODUCTS MFG. CO.
517 E. BUFFALO STREET
MILWAUKEE 2, WIS.

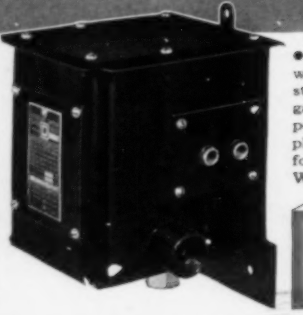
A 4391-¼A

Marine PRESSURE SWITCHES

**DRIPPROOF AND WATERTIGHT
HIGH SHOCK CONTACT BLOCK—
TWO OR THREE POLE—CLASS 9013
TYPE AW-H, MW-H, LW-H**

ELECTRICAL RATINGS

Voltage	Single Phase A.C.	Polyphase A.C.	D.C.
110V.	2 H.P.	3 H.P.	1 H.P.
220V.	3 H.P.	5 H.P.	1 H.P.
440-550	5 H.P.	5 H.P.	......
32V.	......	......	½ H.P.



- Built for Marine Service to conform with requirements for dripproof and watertight devices of shockproof construction. The switches differ from standard in the use of a special sheet steel enclosure and drip hood with gasket seal and a special high shock bakelite contact block in two or three pole form. The three types AW-H, MW-H and LW-H represent three diaphragm sizes and three range and differential variations. A release valve for air compressor service may be added to any of the types, as illustrated. Write for Bulletin 562.

REGULATOR DIVISION
SQUARE D COMPANY
DETROIT • MICHIGAN

BUY ALL THREE FOR ONLY $6.00

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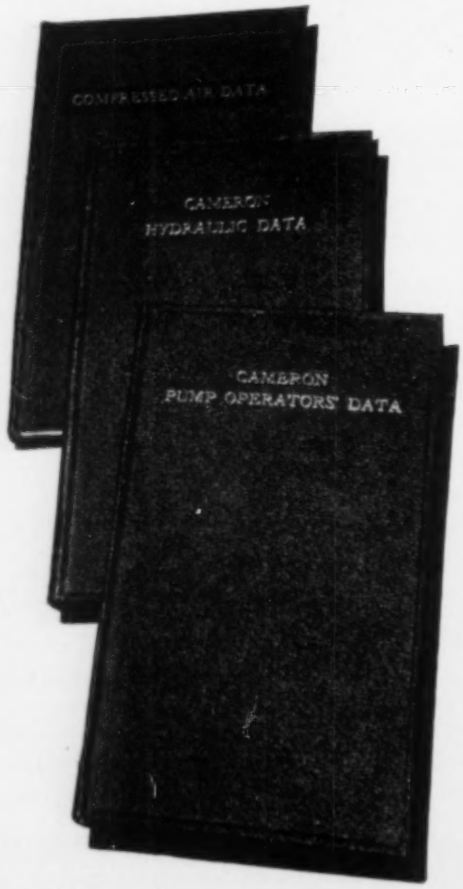

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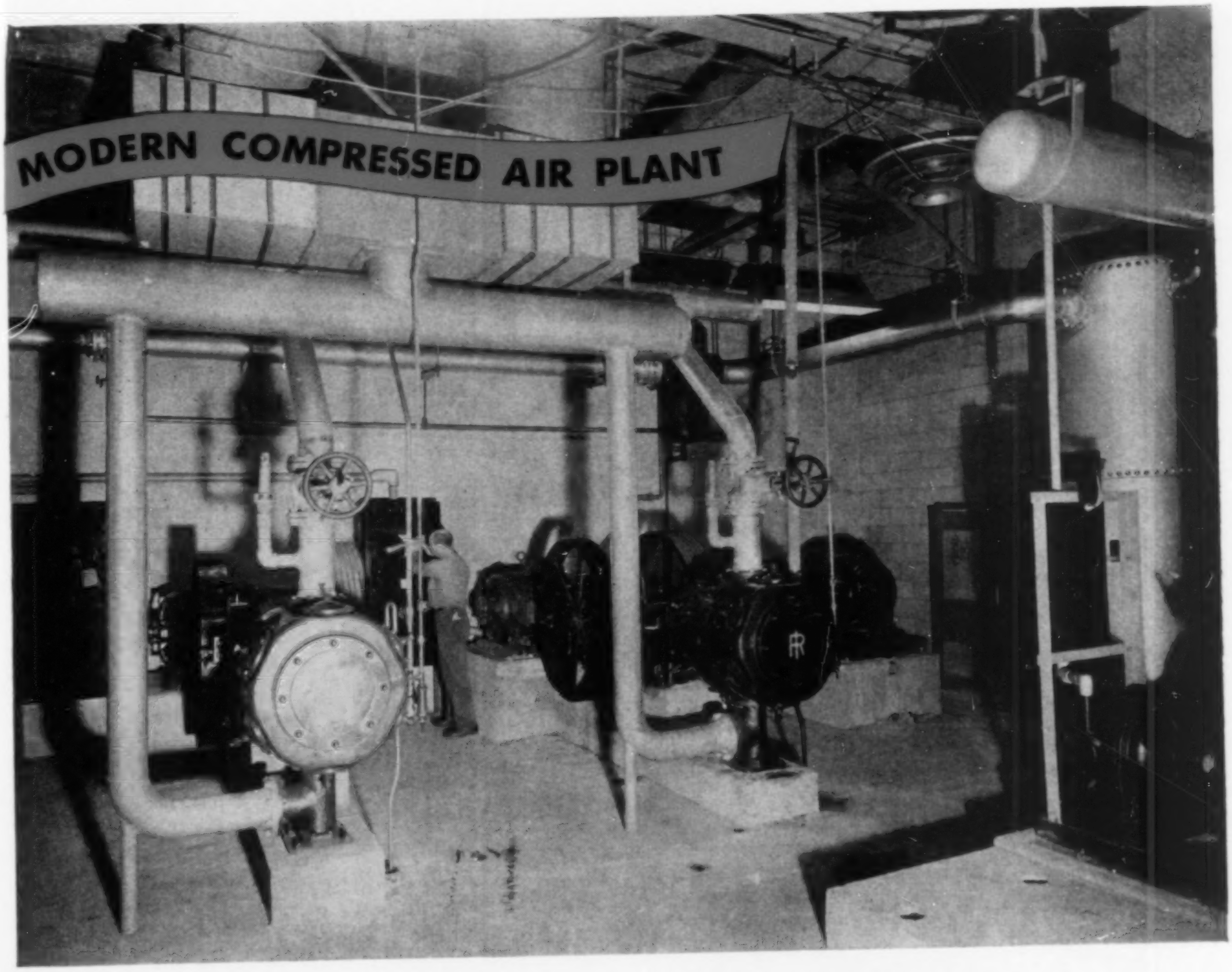

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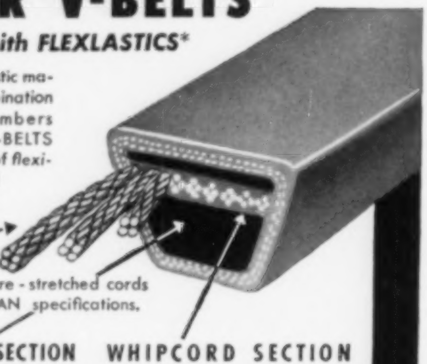

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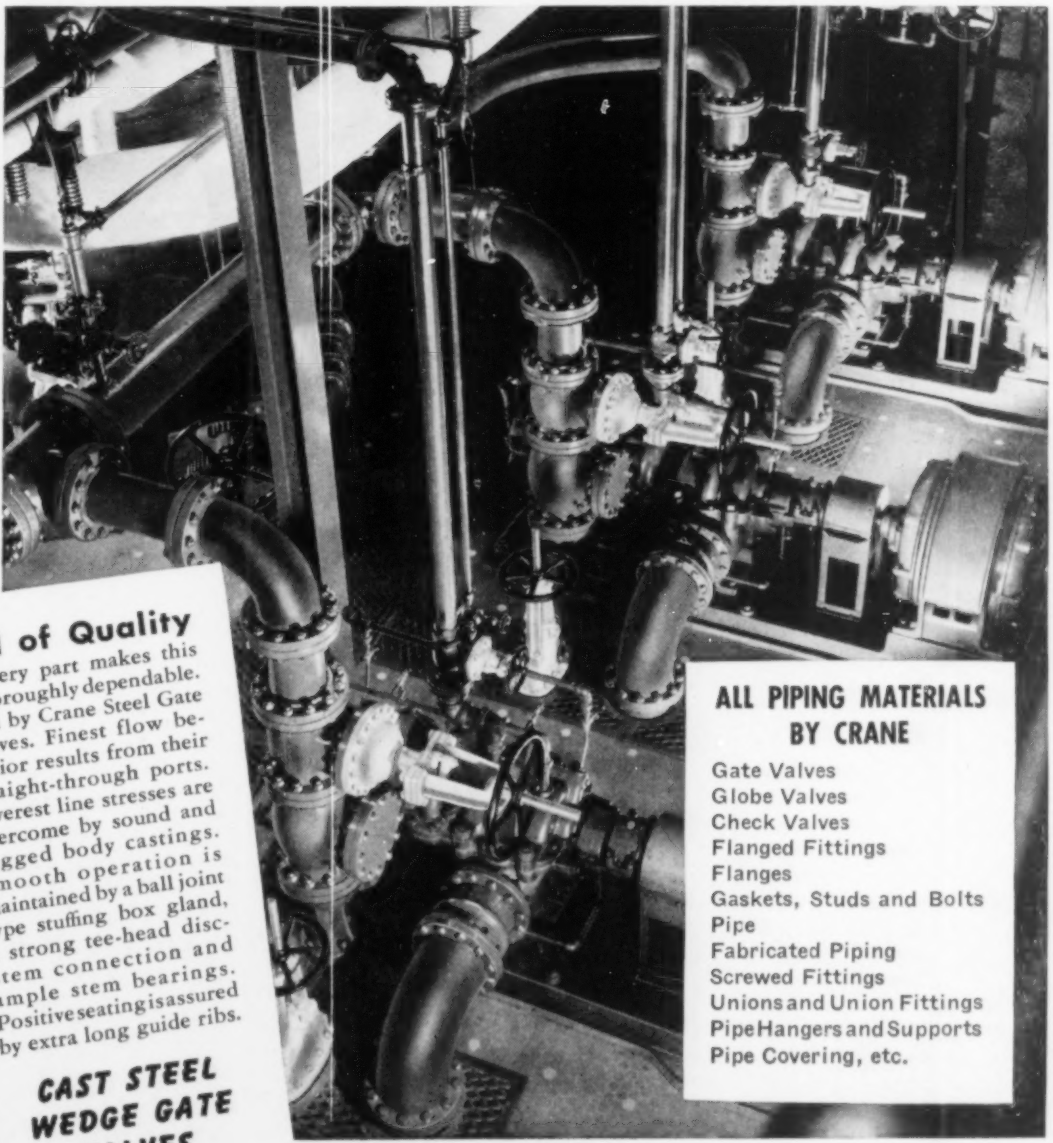

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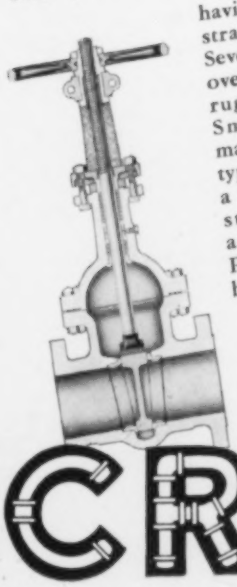

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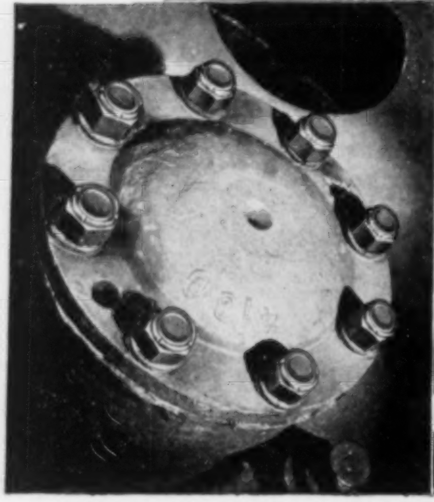

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